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# High frequency propagation anomalies.

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# HIGH FREQUENCY PROPAGATION ANOMALIES

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# THESIS

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by

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## ABSTRACT

This is a report of a search for propagation anomalies using a large quantity of high frequency data produced as a byproduct of BRIGHAM, a Department of Defense project. The BRIGHAM data is based on 890 KHz wide samples of the HF spectrum at a 25 cycle rate, using a 2.8 KHz resolution for a duration of approximately 2.5 minutes. This method of data collection is unique and it was hoped that propagation anomalies, including wide band anomalies, might be detected. Anomalies are believed to occur in the propagation of radio signals and they are usually other than known, routine effects but may include known effects which cannot adequately be explained. The scope of this examination was limited to the visual analysis of computer processed data presented on an interactive graphics unit.

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# I. OBJECTIVES

This project provided the opportunity to examine unique data gathered with the AN/FLR-15 wide-band scanning receiver and the AN/FRD-10 circularly disposed antenna system. The project was suggested by the availability of this large volume of data which had been gathered at great expense for another purpose. The data seemed to offer great potential and the possible basis for considerable research and understanding about electromagnetic propagation. The initial concept was to observe data in the different form of a 3-dimensional contour of amplitude, frequency and time. This concept included the use of a computer and interactive graphics unit to vary the size and dimensions of the contour to obtain a new view of the high frequency region of the spectrum and perhaps observe propagation characteristics not easily recognized otherwise.

The objectives of this project were to take the given sets of data, write the computer programs necessary to present the data visually and to analyze the data. The objectives of the analysis were twofold: To study propagation effects on high frequency signals, becoming familiar with the data, the mode of visual presentation and the appearance of routine propagation effects; To look for unusual and anomalous propagation effects.

## II. INTRODUCTION

It is stressed that the scope of this effort was confined to a visual analysis of the data for detecting unusual patterns and anomalies which could be attributed to propagation conditions. The search was conducted in the high frequency region (3-30 MHz) using data on computer cards. The data cards were produced during a phase of BRIGHAM, a project conducted for the Department of Defense by Sanders Associates, a private corporation. Each data set represents the output of a swept-tuned panoramic receiver and preserves amplitude information vs frequency and time. For visual presentation, the data were processed on a Scientific Data Systems XDS 9300 computer and displayed on an Adage AGT/10 graphics unit (figure 1). The equipment is part of the Electrical Engineering Computer Center of the Naval Postgraduate School. Interesting sets of sweeps have been extracted as one picture, plotted on a CALCOMP 563 plotter and included in this report. Forty-six data sets were available for examination, each consisting of 7195 cards. Several data sets were examined in detail with the intent of using other sets for verification of observed anomalies. Recommendations for further examination are given at the end of this report.

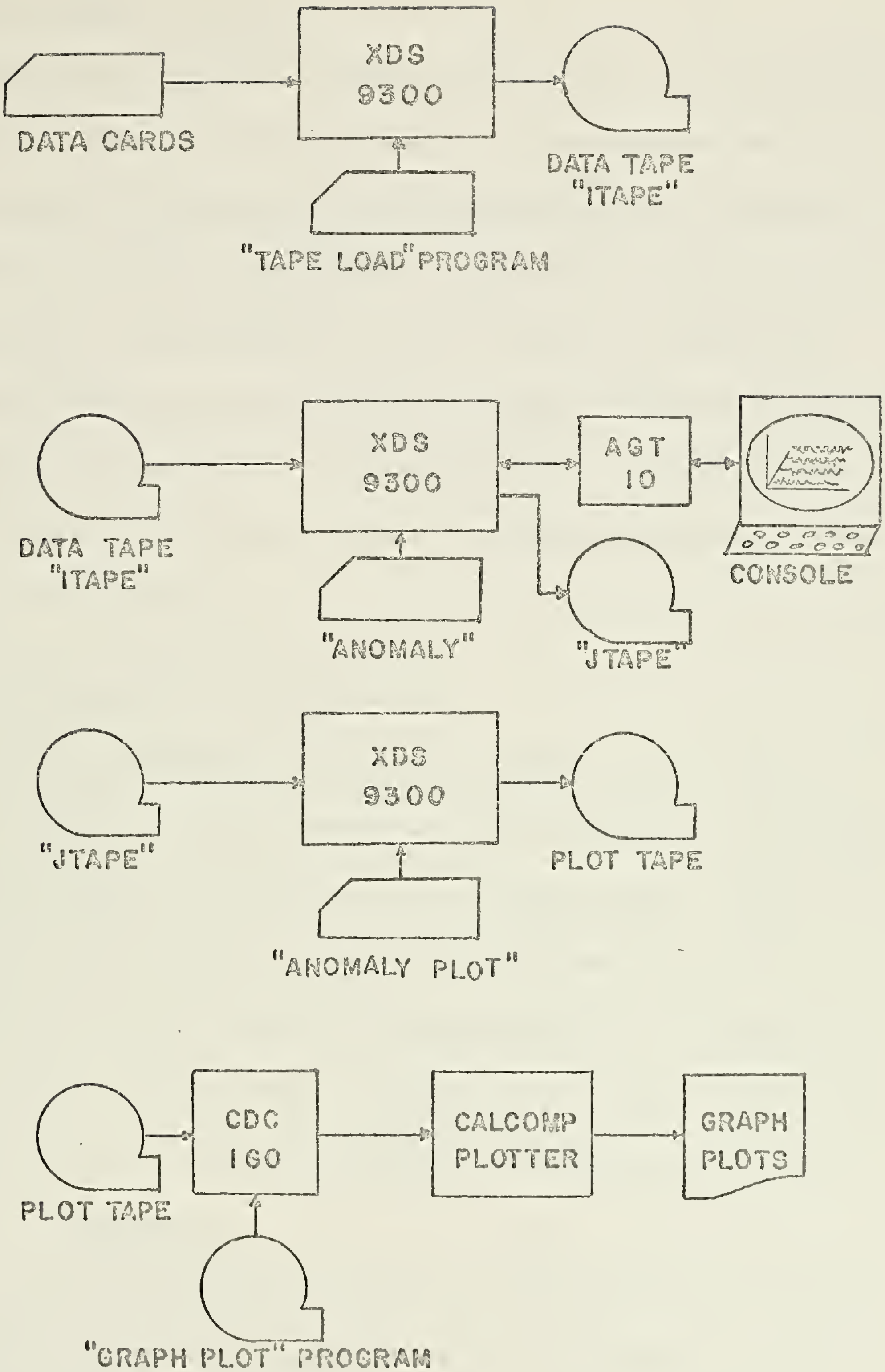



FIGURE 1: THE VARIOUS STAGES OF PROCESSING DATA

## A. NATURE OF THE DATA

The data were gathered using a swept-tuned receiver and either an omnidirectional or a $12^{\circ}$ beam antenna. Each data set was produced by sampling the receiver output as it scanned downward through an 890 KHz band. Sets were gathered at different base (starting) frequencies and at different times of the day. The sets contain the amplitude (in db) of the 318 contiguous frequency bins (sampling points) and consist of 7194 cards to represent the 3597 scans. The initial card in each set contains date, time and parameter information (frequency, etc.) for that set.

## B. PRESENTATION OF THE DATA

Computer programs for (1) transferring the data from cards to tape, (2) visual presentation of the data and (3) extraction of the data for graph plotting are included at the end of this report. There are two computer programs for presenting the data and they reflect the trade-off between the width of the displayed spectrum and the number of scans which could be viewed simultaneously. This restriction was due to core memory size in the XDS 9300 and again in the AGT/10.

### 1. <u>Anomaly A</u>

This program was used for viewing the data as a contour and required appreciable dimensions in time and frequency to be of use. It was initially adapted from a library program but, along with

two accompanying subroutines, was changed almost entirely in adapting it to the BRIGHAM data. Anomaly Plot A was used with this program for plotting graphs. The data were displayed as shown in figure 2 with the most recent scan at the bottom of the picture. For each picture change, a new scan was brought on at the bottom and the oldest scan moved off at the top. The scans were not moved up in a continuous or movie-like fashion but all shifted upward a step at a time to replace previous scans. Options were available for bringing on more than one scan at a time. The amount could be varied so as to change the entire picture at once if desired. Scans could be skipped, taking every fifth or tenth scan for example, effectively decreasing the receiver sampling rate to accentuate long term or slowly changing trends in the data. Also, the time axis could be rotated to vary the 3-dimension or surface contour effect. Other features are described in the computer program section. An optimum size of 130 bins and 20 scans was chosen for this program. A deficiency in this presentation was that amplitude changes with time were not easily observed. To overcome this, the Anomaly B program was written. The scale at the bottom of figure 3 and all the graphs is 10 frequency bins (28 KHz) per division. The leftmost bin in each group is labeled with the computer variable ISTRT, for the integer value of the "starting" bin. ISTRT is a NAMELIST variable and its value can be changed at the graphics console. It enabled the viewer to look at different

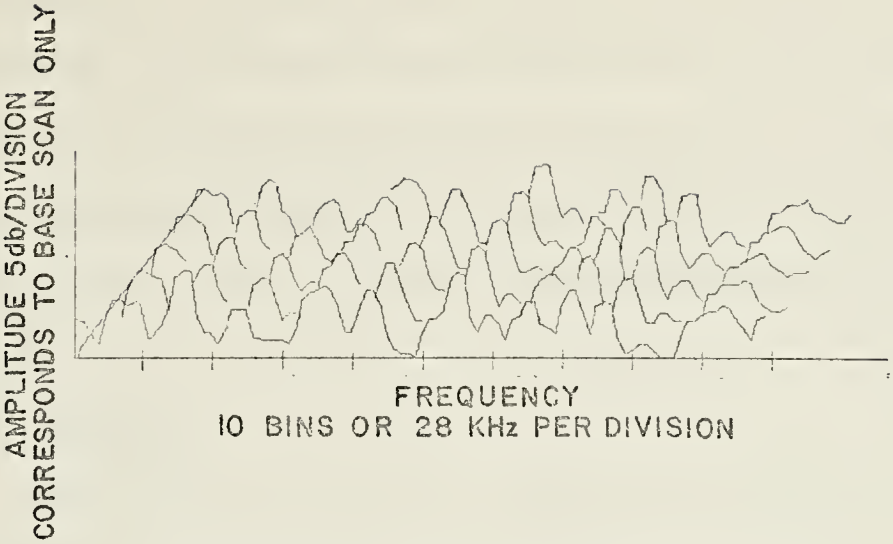



FIGURE 2: "ANOMALY A" PRESENTATION

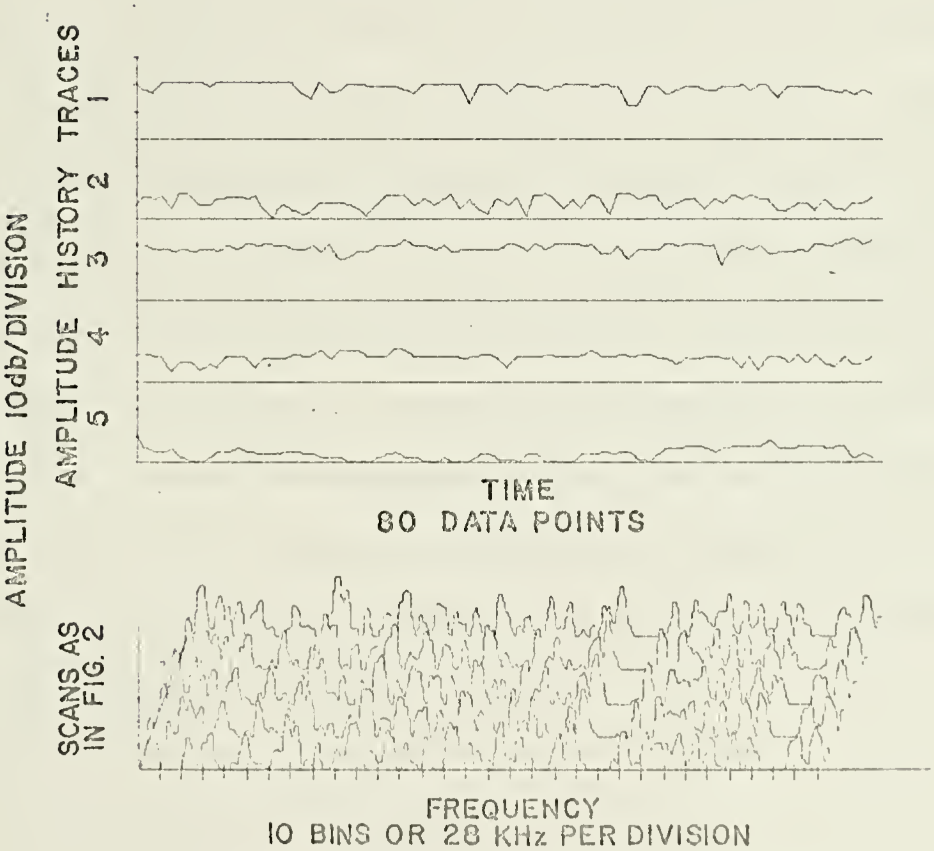



FIGURE 3: "ANOMALY B" PRESENTATION

portions of the band. For identification, bins are located by counting to the right from the starting bin (frequency decreasing toward the right). The vertical scale of the Anomaly A presentation is 5 db of amplitude per division (referred to receiver sensitivity). Scans are spaced 1/25 second apart in time or multiples thereof when scans are skipped.

2. <u>Anomaly B</u>

This program was used to examine more carefully the changes in amplitude among a number of signals (see figure 3). At the top are five traces of signals chosen by specifying the bin number. The traces show the amplitude history of each signal up to a maximum strength of 30 db each, beginning with the present base scan at the left and extending to the right, showing the last 80 scans. The amplitude was displayed after taking the maximum value of the signal in three bins (the one selected and one on either side) and scaling it. At the bottom are displayed all 318 bins to aid in selecting the five signals to be viewed. Because of the memory size trade-off, only five scans are shown simultaneously. The vertical scales differ from those in Anomaly A. Because of a smaller scale, the divisions are 10 db apart. Anomaly Plot B was used to plot this display on paper.

# III. ANALYSIS

## A. PRELIMINARY OBSERVATIONS

Before beginning the visual analysis, it was useful to predict the type of displays the data could yield. These preliminary observations helped visualize numerous features and signal variations not due to propagation so that they could be recognized and not be interpreted as anomalies to be checked and verified. Examples of these features included the following:

1. Transmitter characteristics: Turning on and off; different types of keying which affect frequency and/or amplitude.

2. Receiver characteristics: Filters for notching out interfering signals.

Other preliminary observations predicted limitations on the ability to observe valid propagation characteristics which might be present. These limitations were due to receiver characteristics, the nature of the data and the method of visual presentation.

1. Limitations of the receiver: The 890 KHz band restricted the ability to relate the effects on harmonics in the megahertz region and the ability to observe variations over a wide band.

2. Limitations due to the data: The lack of resolution imposed by the 2.8 KHz wide frequency bins was expected to make it impossible to measure slight variations in frequency. Better resolution could provide better identification of the types of signals present for the purpose of selecting ones with more stable transmitted

characteristics to permit more reliable analysis and measurement. The short duration (2.5 minutes) sample provided a mountain of data but was expected to prevent observation of some propagation characteristics which require a longer period to manifest themselves.

3. Shortcomings in the visual mode of presentation were not foreseen until much later in the project. At first only a general concept of the type of presentation existed and the final characteristics were considerably different. In fact, Anomaly B was developed only after much analysis and frustration with Anomaly A. It should also be noted that although the B version was developed last, it was not a replacement and both programs complement each other.

## B. PROCEDURE

After reading a data set onto tape, the data were analyzed using the Anomaly A presentation to examine the entire length and width of the set. The object at this stage was to find gross anomalies in the 3-dimensional contour which might be easily recognized. Hypothetical examples hoped for might have been any of the following: A rapid change in one region only of the contour; similar changes to one or more amplitude humps (signals or combinations of signals) in separated but perhaps related areas of the contour; holes or the absence of signals in limited bands of the contour. The Anomaly B program was then used for more critical analysis of amplitudes over

a longer period. The amplitude-time traces displayed data over a period four times as long as in Anomaly A (80 data points vs the 20 scans) and examined it from a different perspective (abscissa in dimensions of time rather than frequency to examine individual signals).

## C. FINDINGS AND OBSERVATIONS

Data sets 4, 5, 8, 9, 15, 32, 34 and 147 were examined in detail. Set 4 was the first set examined and received considerable attention while being used to develop the first computer program. A routine for numbering each scan and later displaying the number of the base or bottom scan on the screen was developed and became indispensable in helping identify the location of anomalies or unusual data for subsequent observations.

The first unusual feature noted is shown in figure 4 (upper left hand corner). The amplitude hump there is about 4-6 KHz wide and is seen to move downward in frequency with time at a rate of about 250 KHz per second. An effort to trace it through other signals was unsuccessful. The left hand margin represents the upper limit of the band (18 MHz), therefore tracing it at higher frequencies was not possible. The rate of frequency change was too fast to be classified as a "whistler" or "dawn chorus". These phenomena are only found at considerably lower frequencies (several kilohertz) and the bandwidth

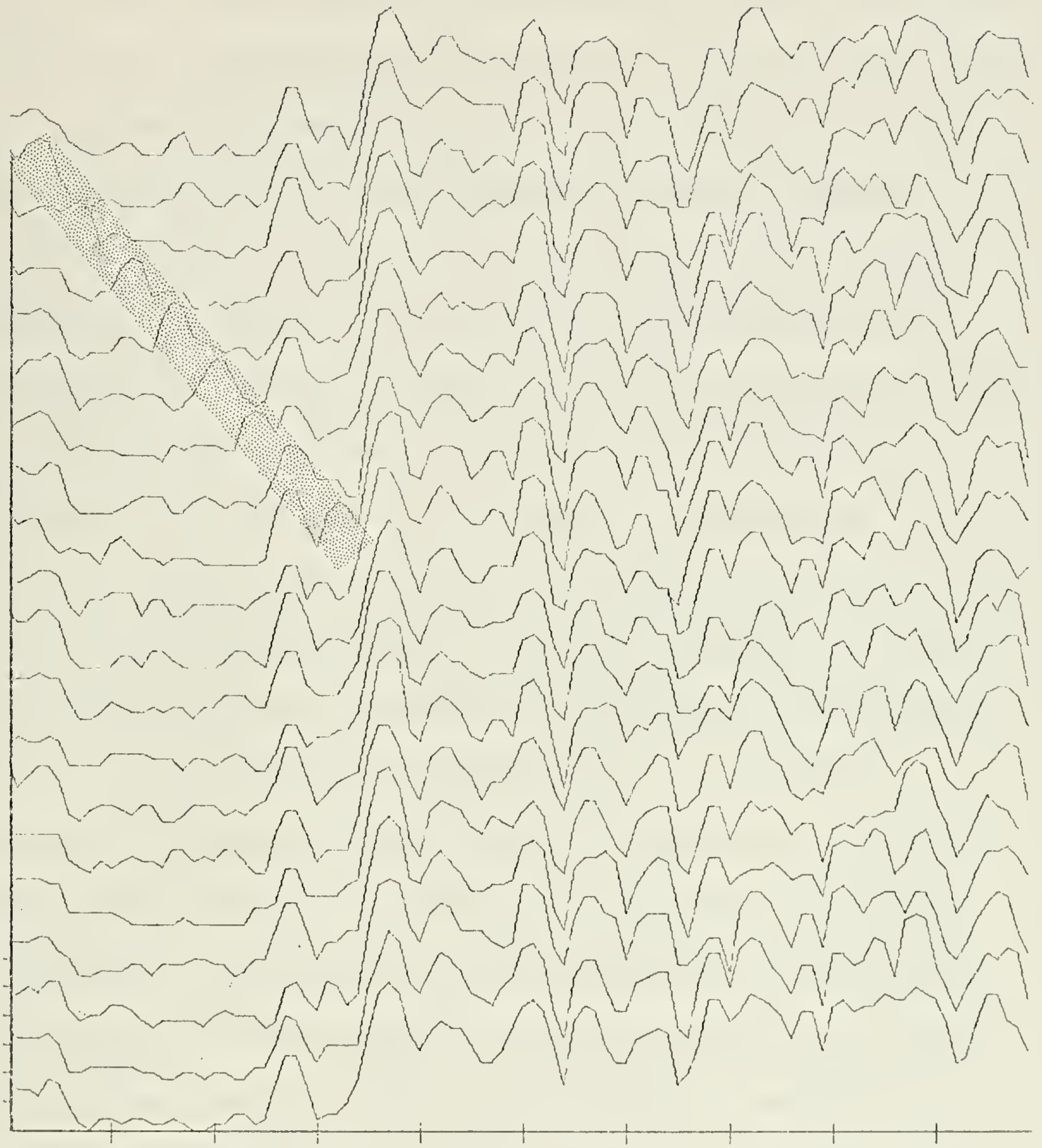


FIGURE 4. Data set 4
ISTRT 1
Base scan 2109
Base frequency 18 MHz

of the amplitude hump was too great for this type of classification. This was the only occurrence of this phenomenon which was observed. It may have been a transmitter being tuned or a special purpose signal.

A feature present in sets 4, 5, 8, 9, 15, 34 and 147 are sudden discontinuities across the entire spectrum of the set. Examples are shown in figures 5 through 7. The transitions were too rapid to be attributed to propagation effects and a satisfactory explanation has not been found. Late in the analysis, in set 34, several pictures from Anomaly A were pieced together (figure 7). The figure shows an effective shift of 160 scans. At one point it seemed to be the result of a missing data card. Two cards are required to describe one scan and if one is missing, the next card and all subsequent cards are all shifted back 160 scans. It would give the appearance on the left half of the scan being exchanged with the right half, as it appears in figure 7. A second missing card would then put them back in the right order, ending the "discontinuity". Unfortunately, this simple explanation was not correct because an examination of the data in the region of the set 34 discontinuity revealed no missing or out-of-place cards. Examination of cards in other sets with discontinuities also revealed no missing cards. The bad data therefore must have been due to some sort of receiver or recording malfunction.

Figure 8, instead of showing any anomalies, shows a set of well ordered, continuous signals of nearly constant amplitude and

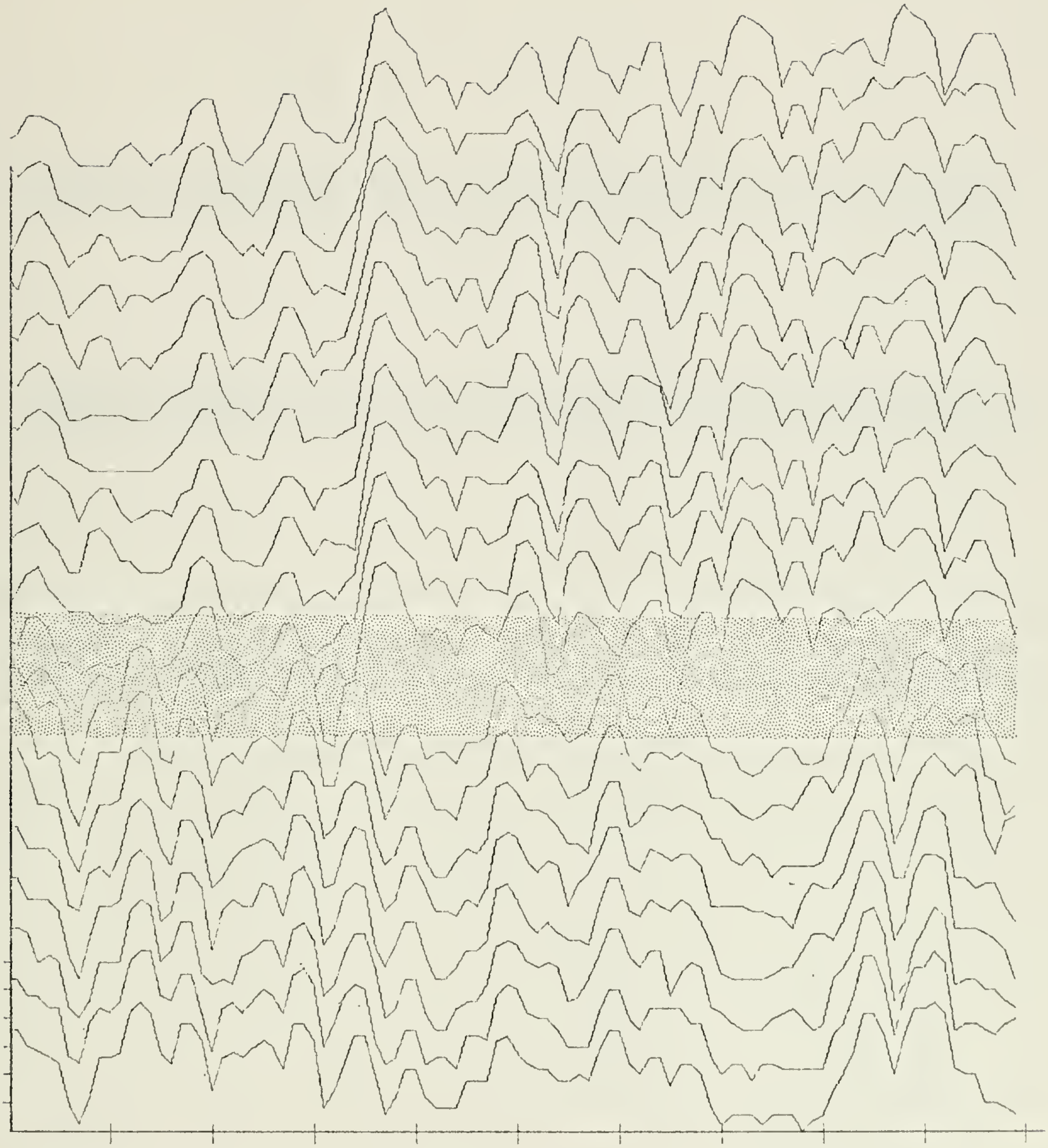


FIGURE 5. Data set 4
ISTRT 1
Base scan 1423
Base frequency 18 MHz

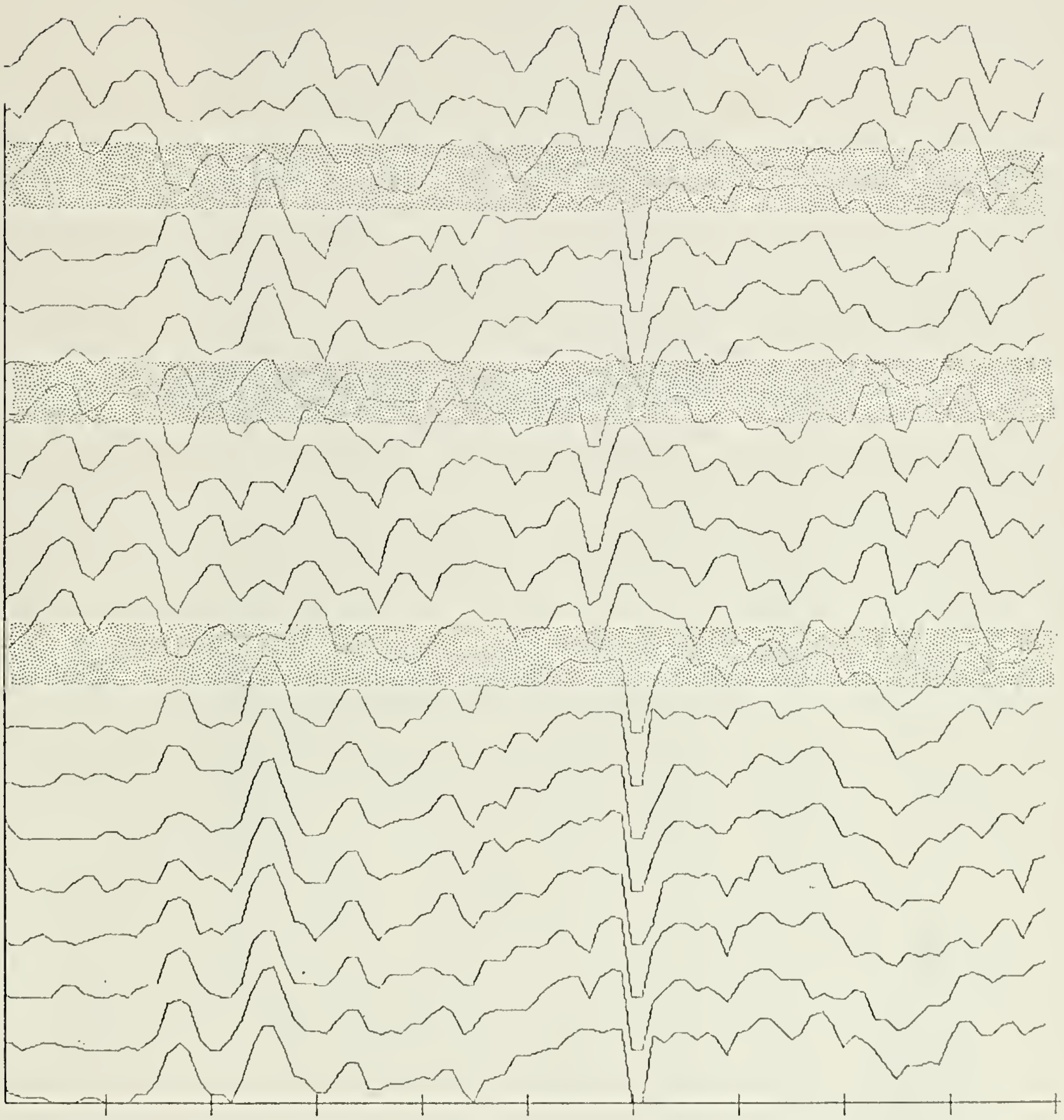


FIGURE 6. Data set 4
ISTRT 100
Base scan 949
Base frequency 18 MHz

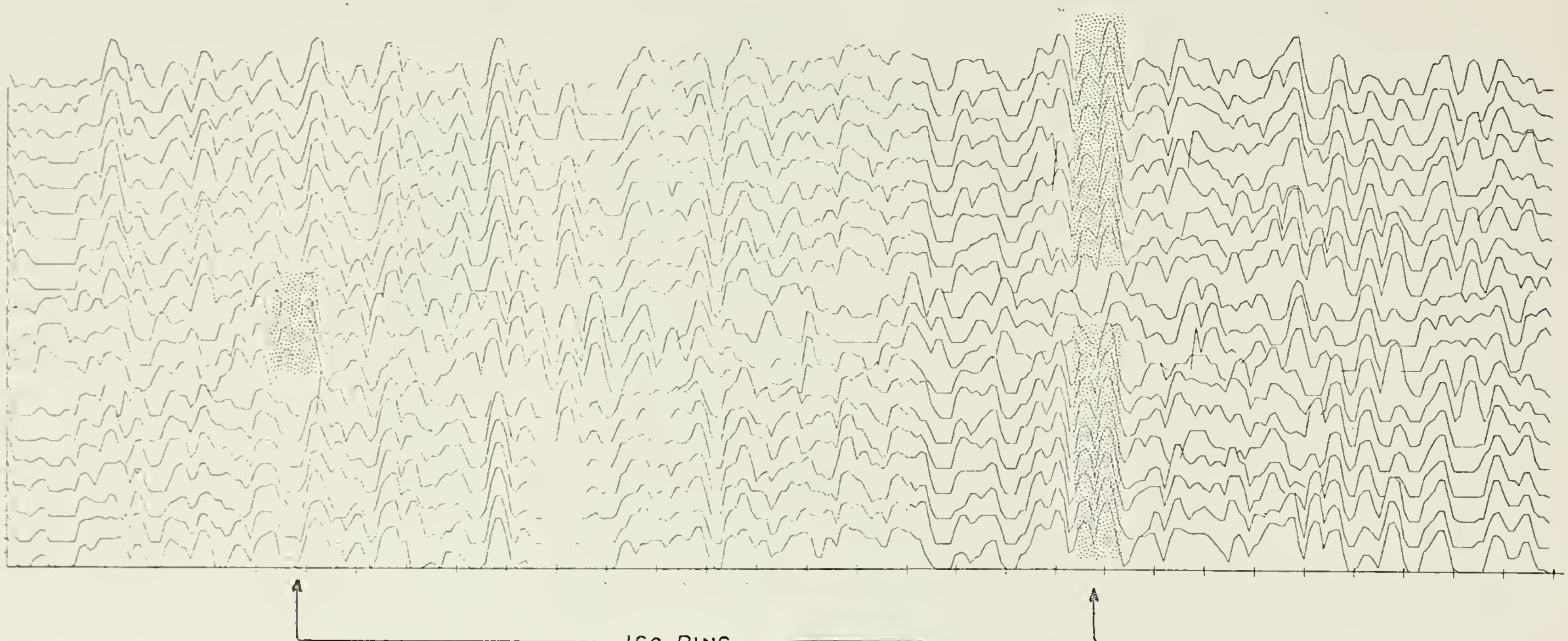



FIGURE 7.

Data set 34
ISTRT 1
Base scan 1651
Base frequency 5 MHz

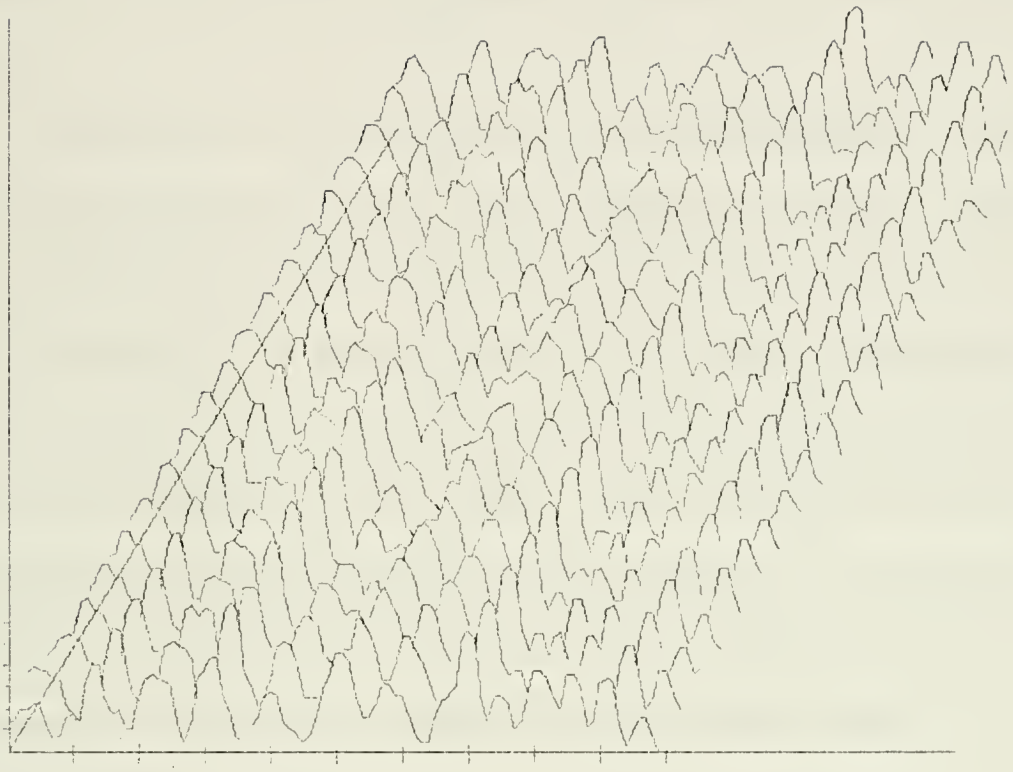


FIGURE 8. Data set 4
ISTRT 104
Base scan 30
Base frequency 18 MHz

shape. This is contrasted in figure 9 by an irregular contour. In addition to variations in amplitude, some signals seem to be turned on and off alternately. The region between bins 30 and 38 contains a signal regularly occurring only once in nearly every three scans. At bin 60, the pattern is irregular and is probably an on-off keyed signal.

When figure 10 was first observed, it was thought that a genuine anomaly has finally been found. Band limited noise seemed to appear first to the right of bin 160 and then spread to higher frequencies before subsiding. The presence of the notch seemed connected also, marking the lower limit during the first scan and persisting before, throughout and after the noise in time. After some study and consideration it was realized that each sweep required a finite amount of time and that the onset of noise appeared, although abruptly, at midscan. It is seen to grow weaker with time before finally disappearing.

Further analysis was conducted with Anomaly B to examine amplitude variations of individual amplitude humps. Examination was begun in set 32 because it was free of the discontinuities present in each of the previous sets. Also, set 32 was taken from a $12^{\circ}$ beam antenna rather than the omnidirectional one used in the sets from 4 to 15. The narrow beam was chosen to confine the signals observed to a particular region of origin. Although points of signal origin,

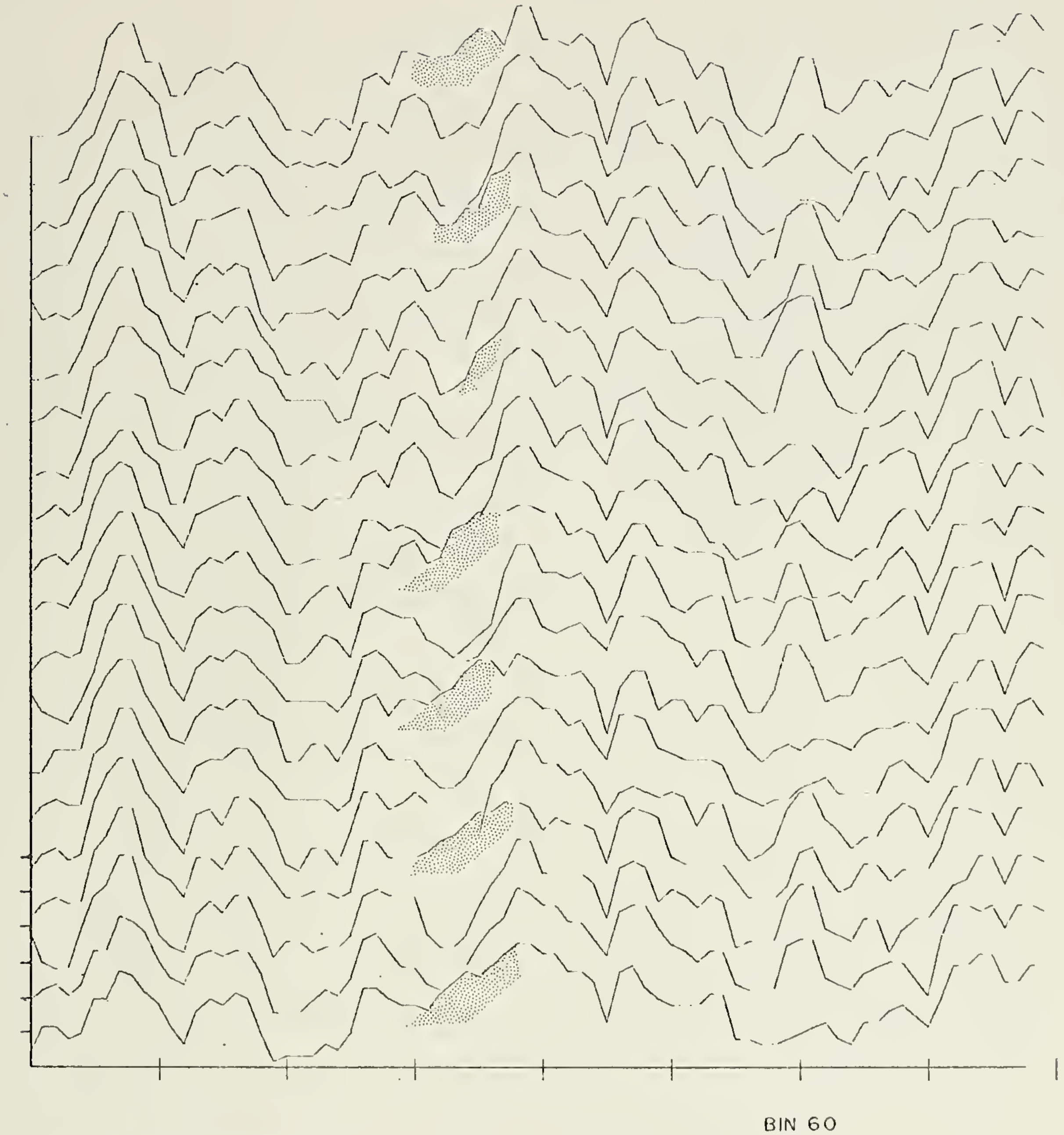



FIGURE 9. Data set 8
ISTRT 1
Base scan 60
Base frequency 5 MHz

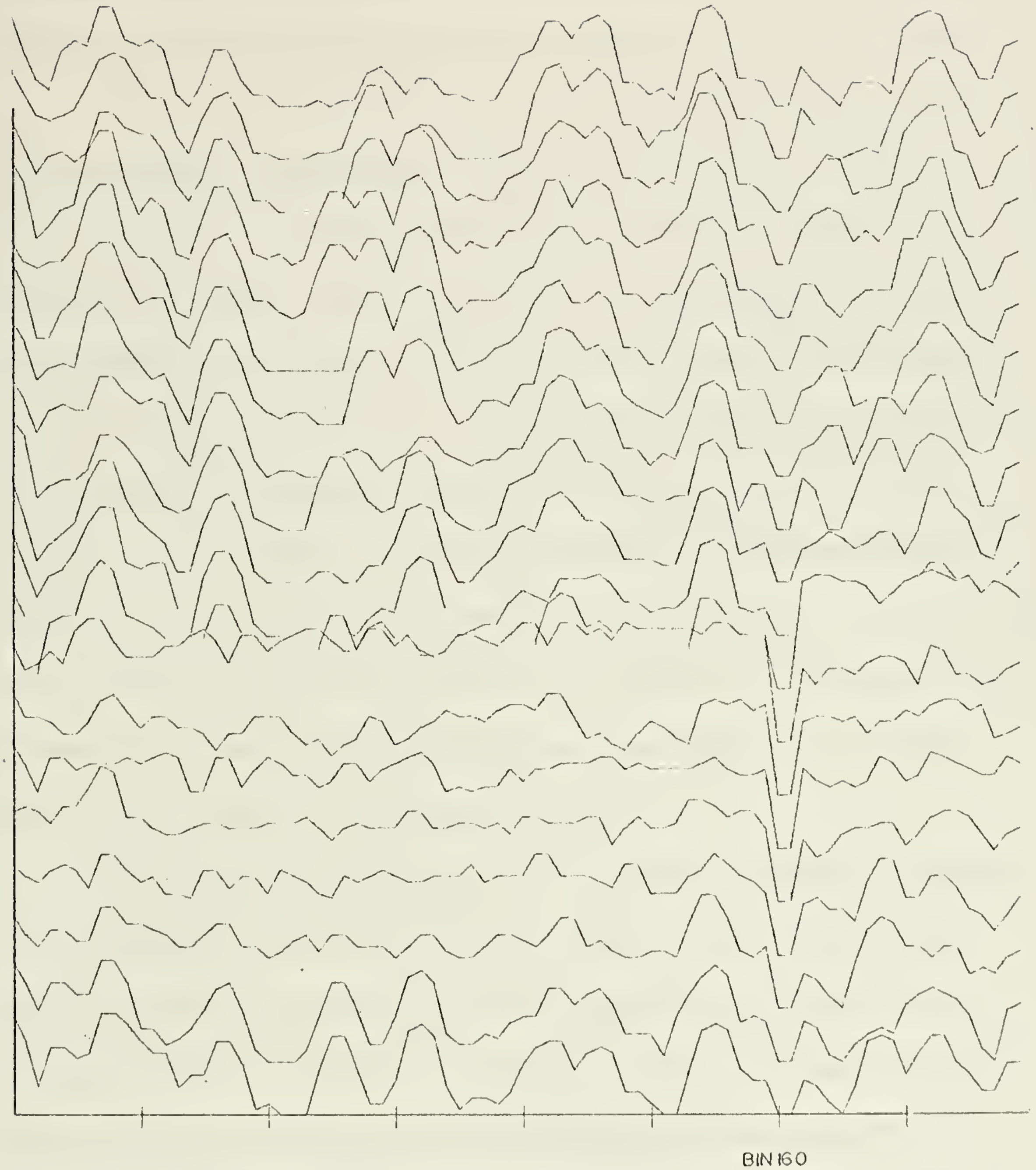



FIGURE 10. Data set 8
ISTRT 100
Base scan 1137
Base frequency 5 MHz

and consequently propagation conditions, would still vary with each signal, the variations would not be as extreme as in the 360° case.

Figures 11, 12 and 13 were extracted from set 32 and compare the amplitudes of signals found in bins 19, 64, 101, 156 and 182. Each of the three figures were drawn with a different sampling rate but have the same terminal or base scan (leftmost points at the top of the figures and the bottom scan in the lower section of the figures). Figure 11 shows every other scan (the variable NSKIP set equal to 1 in the computer program) beginning with scan 2840, covering a 6.4 second period. Figure 12 shows every tenth scan (NSKIP=10) beginning with scan 2200 (covers 32 seconds). Figure 13 shows every 35th scan beginning with scan 200 (covers 112 seconds). The scans at the bottom of each picture represent the entire data spectrum and show the last five scans at the particular skip rate noted.

A few similarities exist between the traces in figures 11 through 13. Propagation effects had been expected to create corresponding dips in amplitude among the signals of similar points of origin (such as those shown) but they were expected to appear over longer periods. On the other hand however, the rapidity of the fluctuations is not unusual. Ionospheric surface irregularities and layer displacements could account for them as described in reference 1. David and Voge [Ref. 2], for example, report that horizontal displacements have been measured by doppler techniques at velocities up to 60-80 miles per

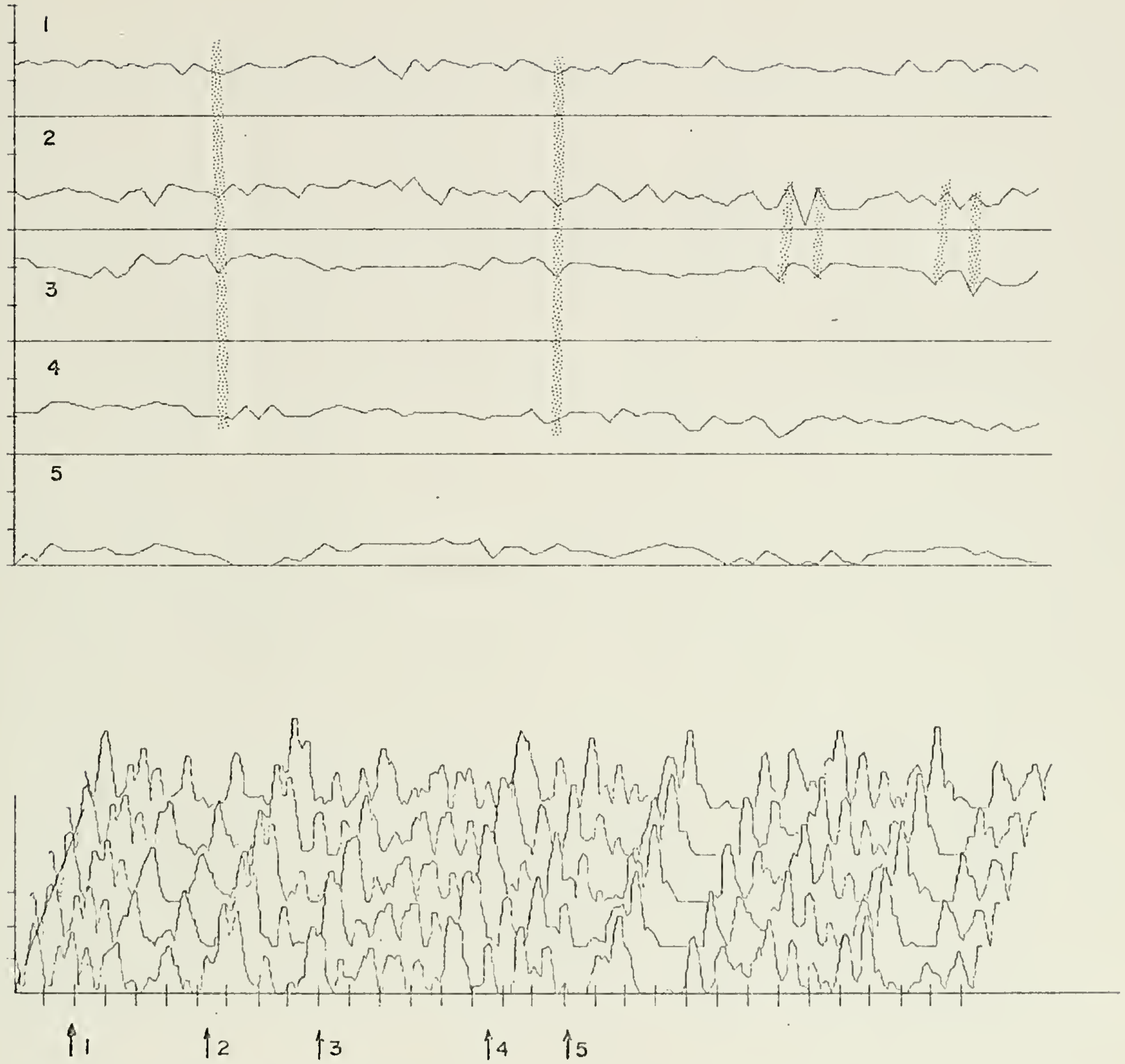



FIGURE 11. Data set 32
Base scan 3000
Base frequency 11 MHz
NSKIP 2
Sample duration 6.4 sec

trace 1 --- bin 19
trace 2 --- bin 64
trace 3 --- bin 101
trace 4 --- bin 156
trace 5 --- bin 182

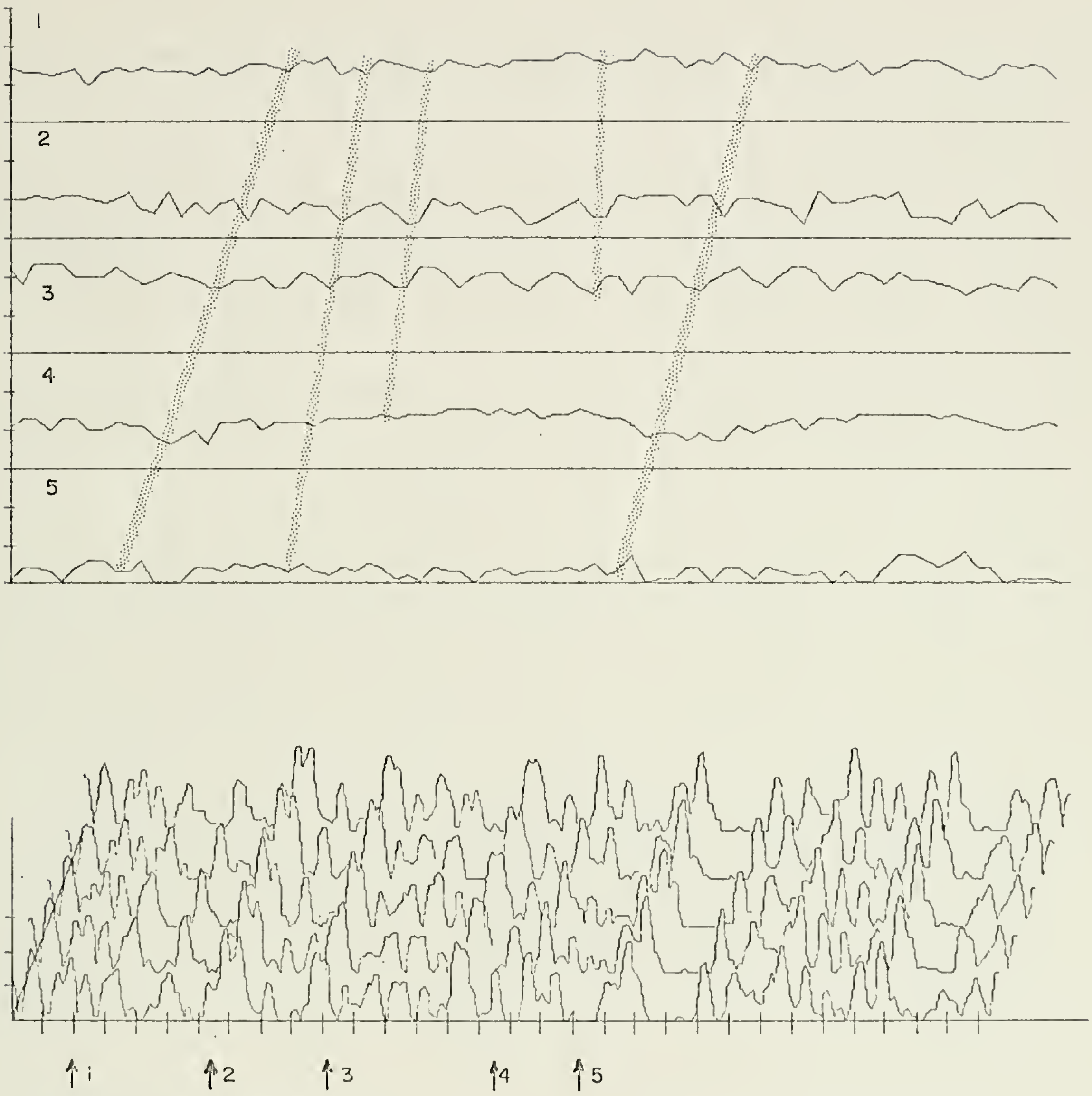



FIGURE 12. Data set 32
Base scan 3000
Base frequency 11 MHz
NSKIP 10
Sample duration 32 sec

trace 1 --- bin 19
trace 2 --- bin 64
trace 3 --- bin 101
trace 4 --- bin 156
trace 5 --- bin 182

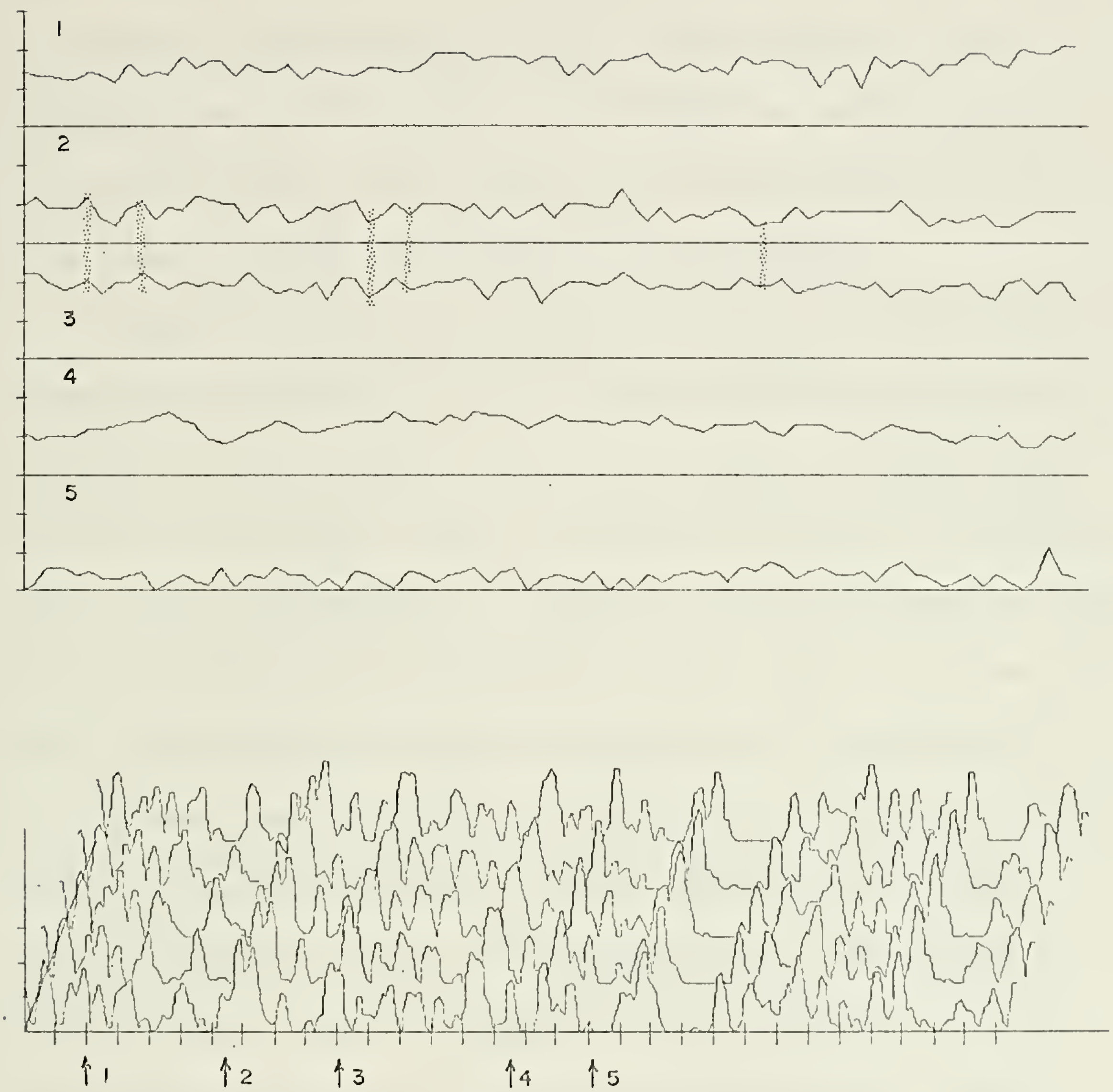



FIGURE 13. Data set 32 — trace 1 --- bin 19
Base scan 3000 — trace 2 --- bin 64
Base frequency 11 MHz — trace 3 --- bin 101
NSKIP 35 — trace 4 --- bin 156
Sample duration 112 sec — trace 5 --- bin 182

hour. At the top right in figure 11, traces 2 and 3 show an inverse relationship. Traces in figure 12 indicate that the higher frequencies were affected first with the effects shifting lower with time. It is realized that since the signals selected for observation here were not equally spaced in frequency, the straight line analysis may not be particularly valid. Also, because of the small number of similarities in these samples, they may only be coincidental.

Figures 14 through 17 were also taken from set 32 but compare the amplitudes of bins 35, 85, 167, 224 and 303. The sampling rates are shown for each figure as well as the terminal scan number and duration of the sample. Figure 14 shows no anomalies or correlation among signals with NSKIP=2. In figure 15, a periodic relation of longer duration seems to exist between traces 1 and 3. The propagation conditions affecting the two signals are similar but with the higher frequency signal (trace 1 at the top) being affected earlier in time. These effects are seen again in figure 16 but at a higher skip rate (dips closer together) where they can be observed over a longer period. No data exists to verify this pattern for the preceding time interval but it does not appear in the following interval (figure 17 - covers the interval from scan 1600 to number 3200 - NSKIP=20 over 80 data points). It may have died out or the display characteristics may have prevented it from being seen. The relationship stands out because of the frequency dependence of the effects. This type of anomaly is characteristic of what was expected when the project was begun.

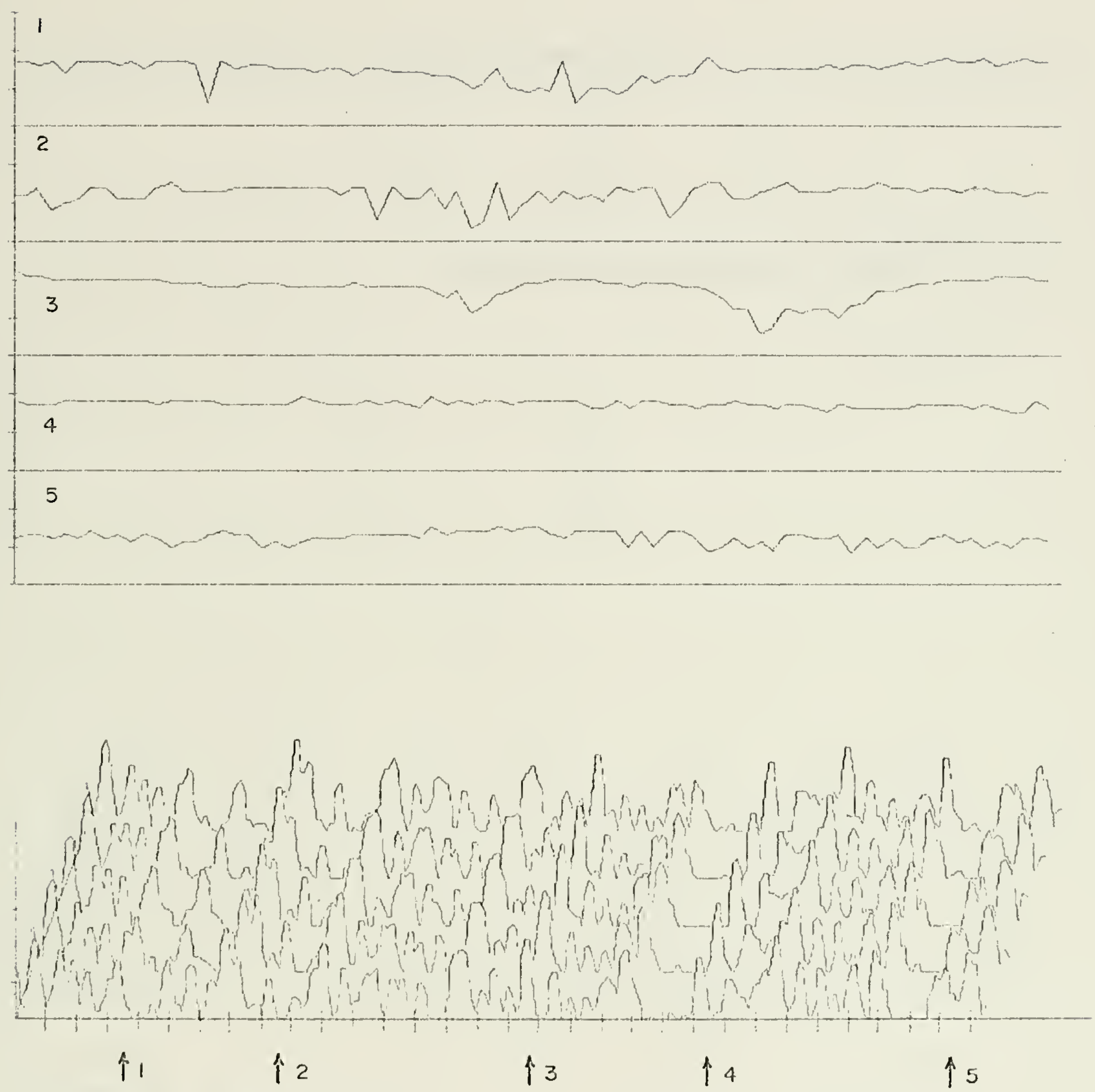


FIGURE 14.

| | |
|---|---|
| Data set 32 | trace 1 --- bin 35 |
| Base scan 750 | trace 2 --- bin 85 |
| Base frequency 11 MHz | trace 3 --- bin 167 |
| NSKIP 2 | trace 4 --- bin 224 |
| Sample duration 6.4 sec | trace 5 --- bin 303 |

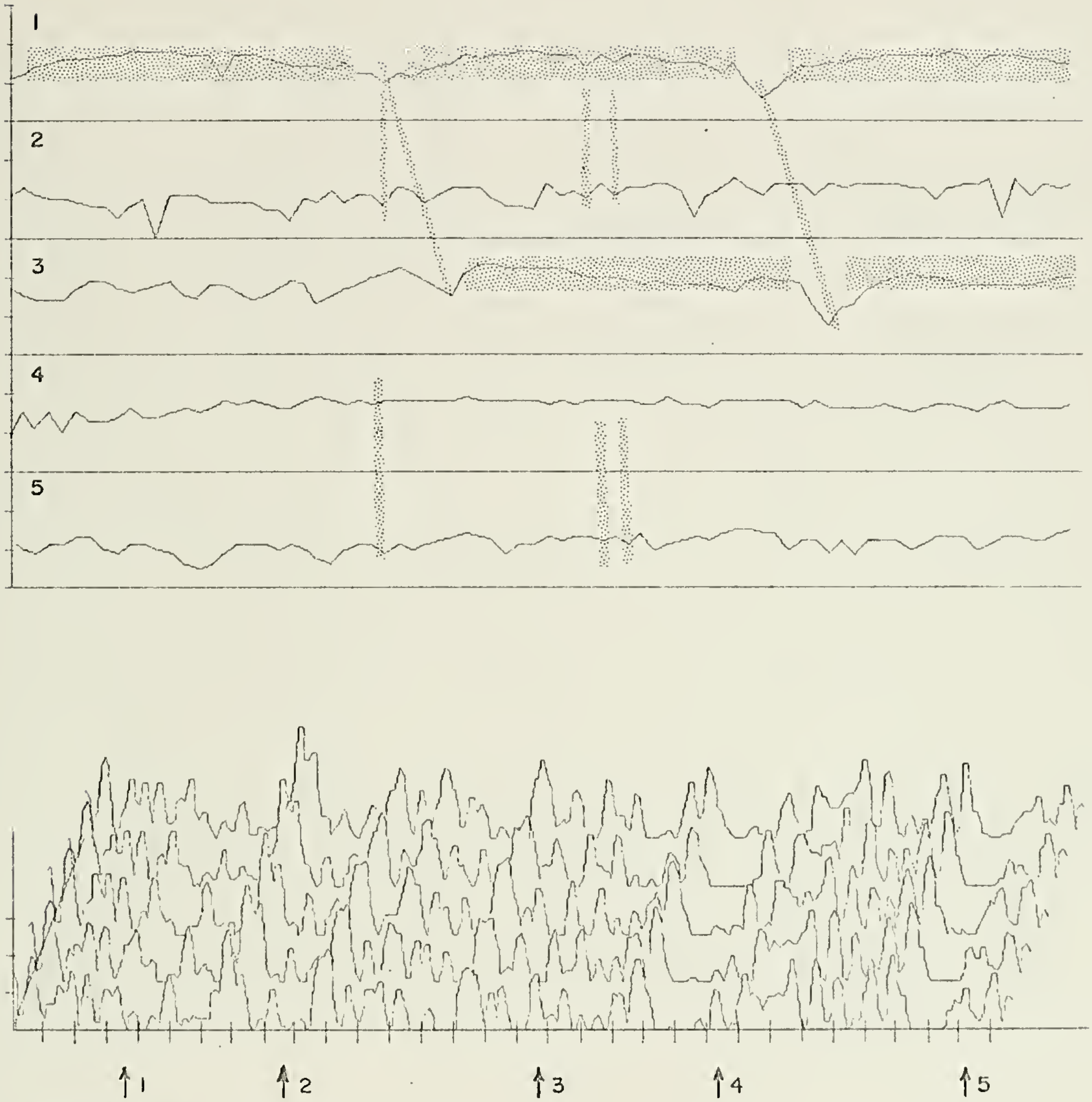
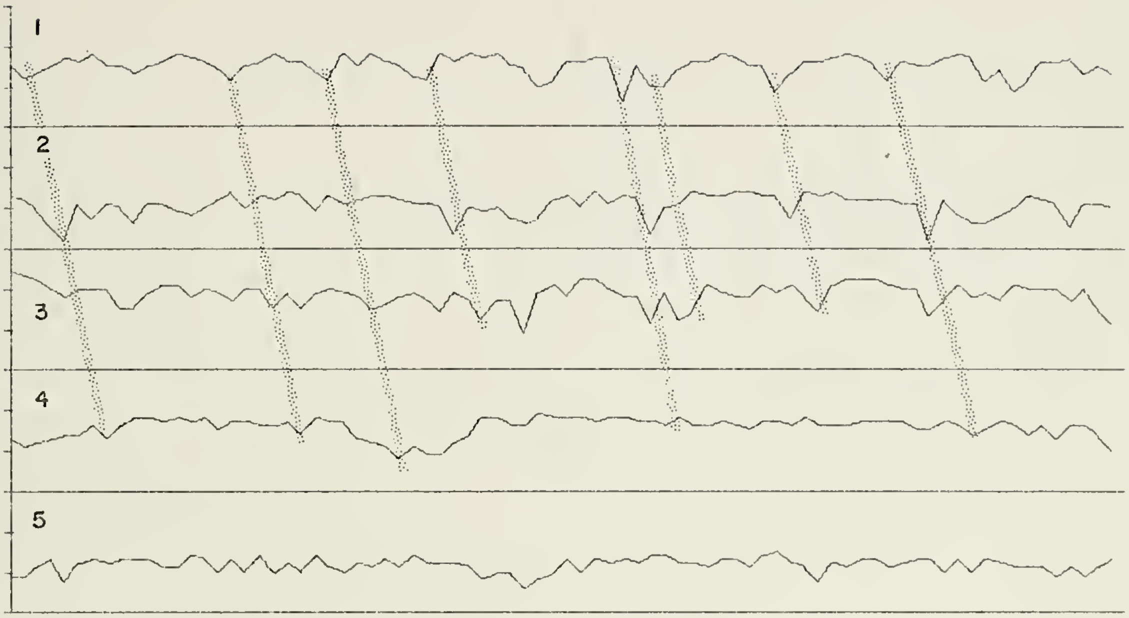



FIGURE 15. Data set 32
Base scan 1000
Base frequency 11 MHz
NSKIP 6
Sample duration 19.2 sec

trace 1 --- bin 35
trace 2 --- bin 85
trace 3 --- bin 167
trace 4 --- bin 224
trace 5 --- bin 303



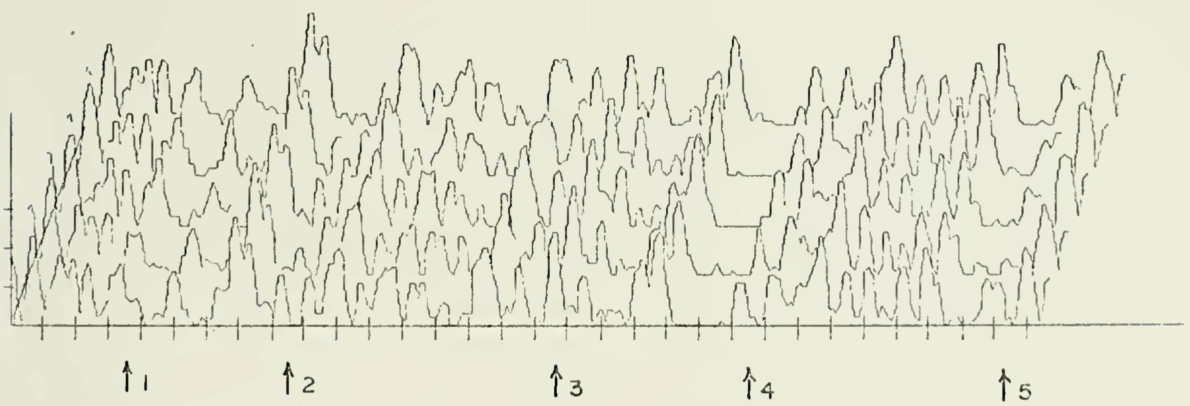




FIGURE 16. Data set 32
Base scan 1600
Base frequency 11 MHz
NSKIP 20
Sample duration 64 sec

trace 1 --- bin 35
trace 2 --- bin 85
trace 3 --- bin 167
trace 4 --- bin 224
trace 5 --- bin 303

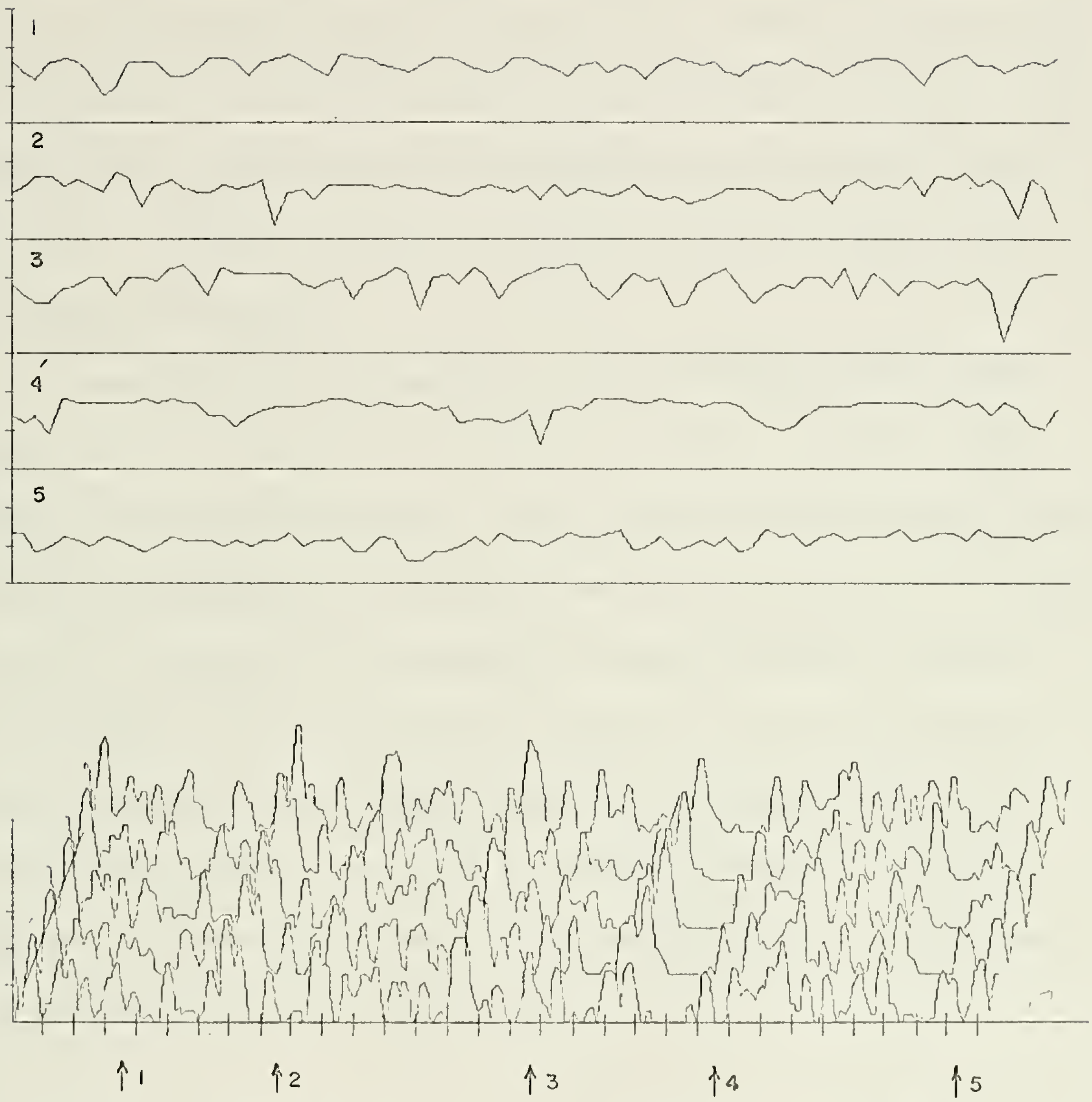



FIGURE 17. Data set 32
Base scan 3200
Base frequency 11 MHz
NSKIP 20
Sample duration 64 sec

trace 1 --- bin 35
trace 2 --- bin 85
trace 3 --- bin 167
trace 4 --- bin 224
trace 5 --- bin 303

Figure 18 shows an unusual relationship between the signals of traces 1, 2 and 3. Two of the signals experienced some sort of attenuation while the signal in the middle was enhanced. A similar inverse relationship was observed in figure 11. The same phenomenon as in figure 18 can be seen in figure 19 but at a higher skip rate. Also present were periodic variations in amplitude, particularly in trace 3. Periodic variations became more pronounced in trace 4 (figure 20) in a later time interval.

In addition to observing those groups of signals already noted, other groups of signals were also chosen in order to sample a wide range of possible combinations. Some groups spread the sample over the entire data spectrum while others were confined to a narrow range of bins. A spread of low and high skip numbers was also included. Specifically, the following groups of signals in set 32 were among those examined but with nothing significant observed: Bins 3, 9, 16, 21 and 25 with NSKIP equal to 1, 4, 16 and 40; Bins 135, 147, 158, 168 and 177 with NSKIP equal to 3, 12 and 45; Bins 8, 13, 17, 22 and 27 with NSKIP equal to 2, 10 and 35.

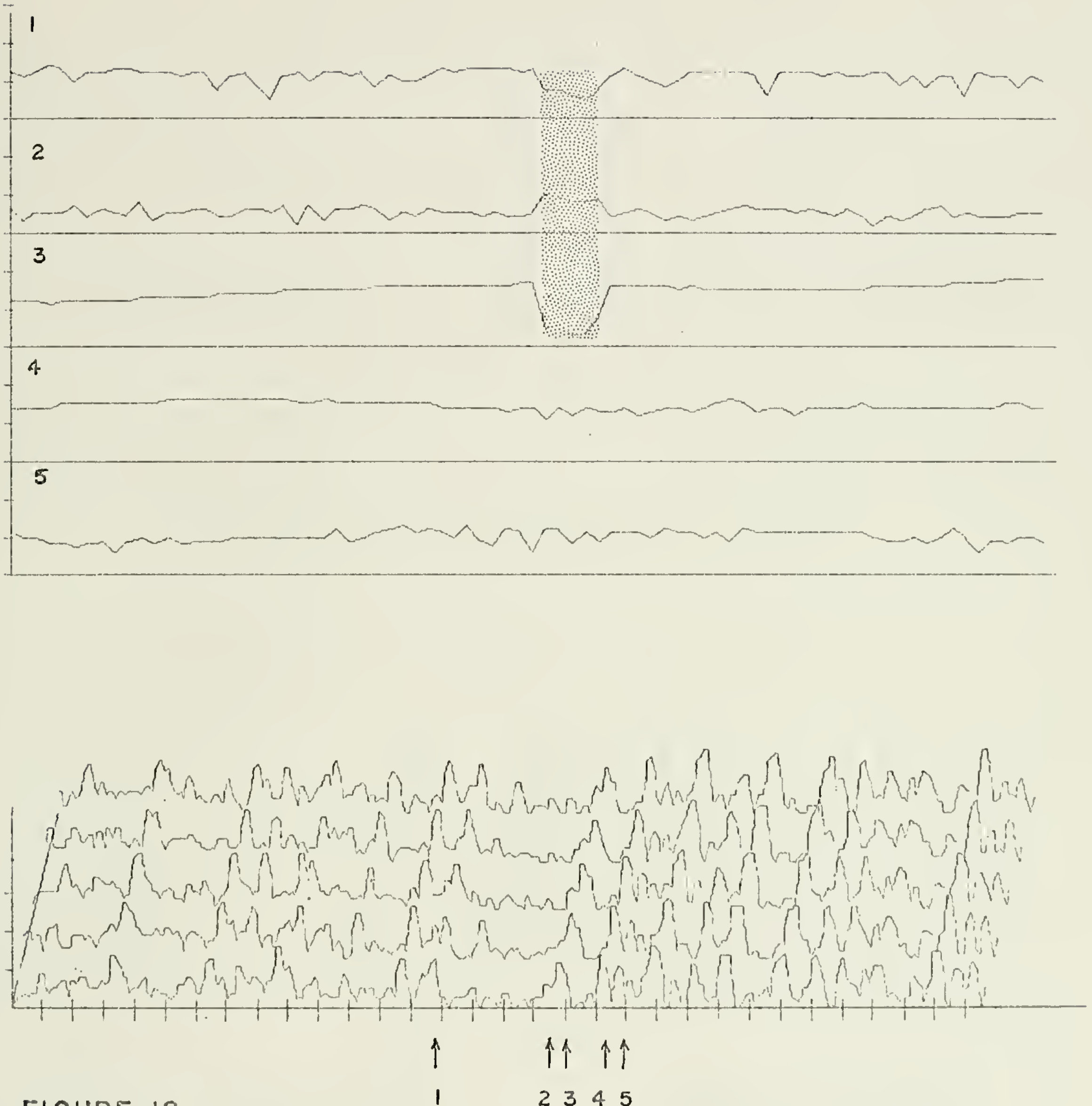



FIGURE 18.

| | |
|---|---|
| Data set 147 | trace 1 --- bin 138 |
| Base scan 710 | trace 2 --- bin 175 |
| Base frequency 16 MHz | trace 3 --- bin 180 |
| NSKIP 1 | trace 4 --- bin 194 |
| Sample duration 3.2 sec | trace 5 --- bin 199 |

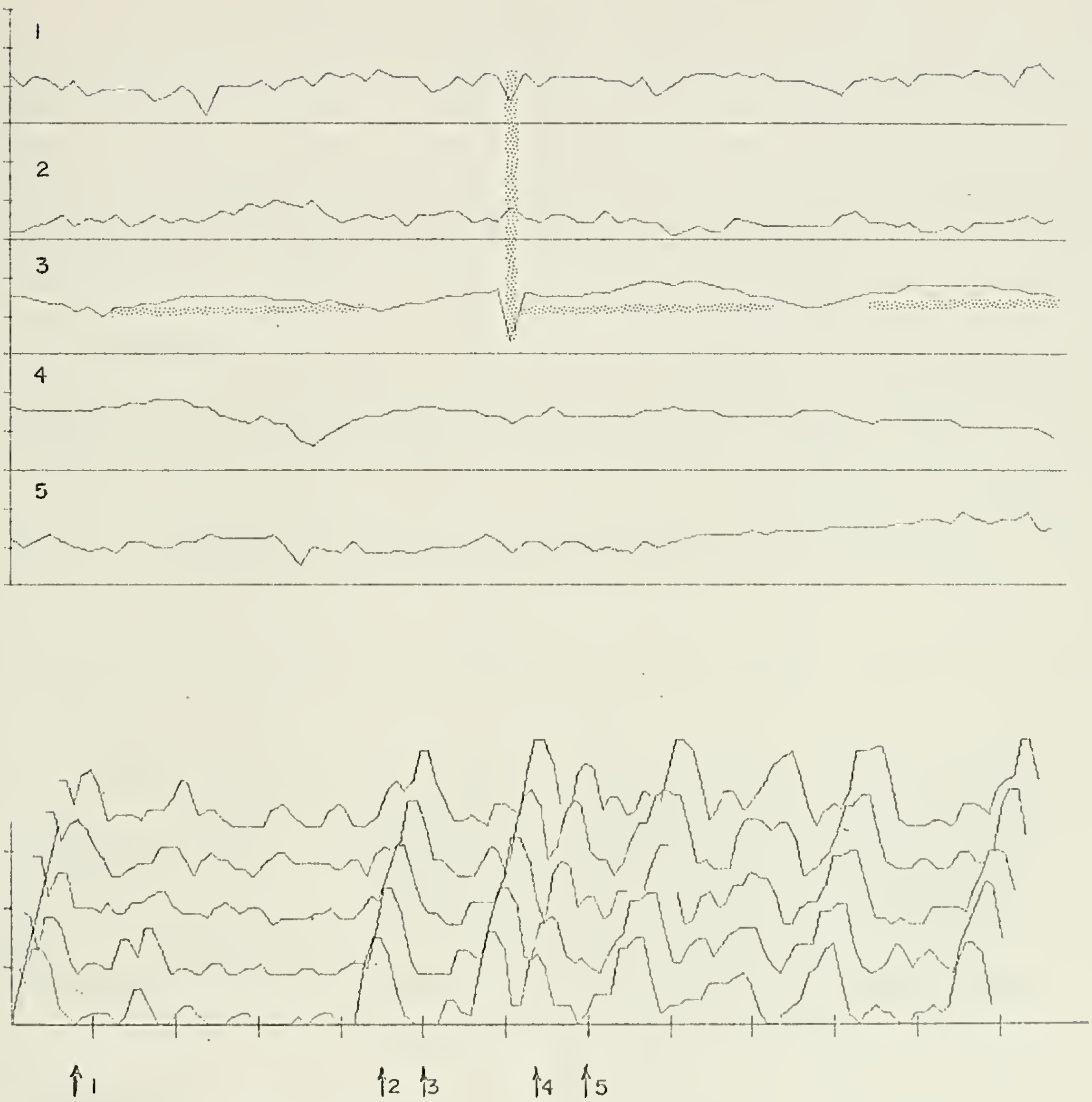



FIGURE 19. Data set 147
Base scan 820
Base frequency 16 MHz
NSKIP 4
Sample duration 12. 8 sec
ISTRT - 135

trace 1 --- bin 138
trace 2 --- bin 175
trace 3 --- bin 180
trace 4 --- bin 194
trace 5 --- bin 199

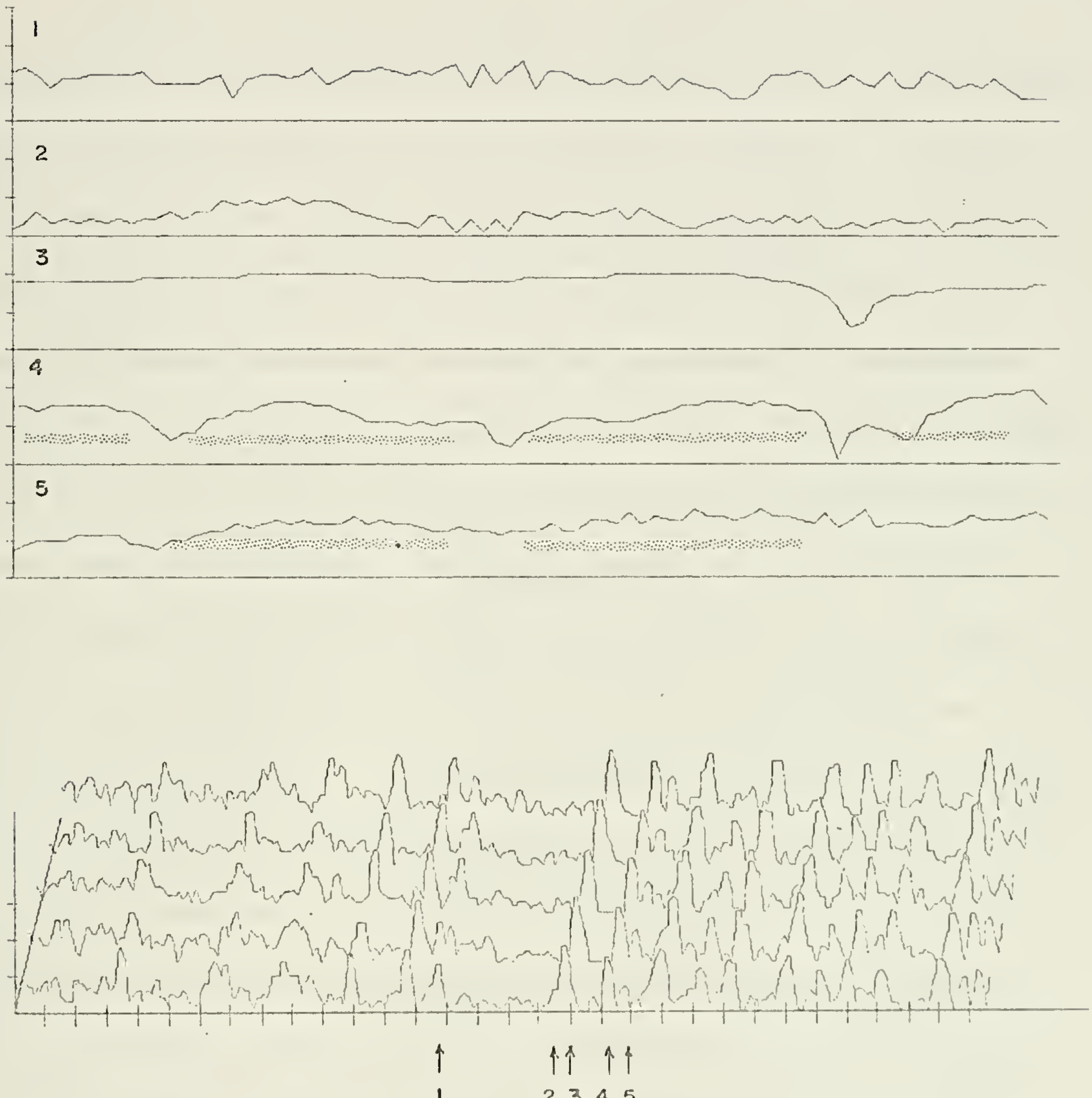



FIGURE 20.

| | |
|---|---|
| Data set 147 | trace 1 --- bin 138 |
| Base scan 2675 | trace 2 --- bin 175 |
| Base frequency 16 MHz | trace 3 --- bin 180 |
| NSKIP 4 | trace 4 --- bin 194 |
| Sample duration 12.8 sec | trace 5 --- bin 199 |

## IV. CONCLUSIONS AND RECOMMENDATIONS

Although a tremendous amount of data was available as a by-product of project BRIGHAM and a large quantity of it was examined in detail during this effort, the many anomalies hoped for at the beginning were not seen. Three significant phenomena were observed and preserved in this report. The first, the signal decreasing in frequency with time was almost certainly not a product of a propagation anomaly. Its identification might prove to be an interesting challenge, however. The second phenomenon showed that its periodic features were frequency dependent. Although periodic fading or intensity fluctuations were noticed at various times while examining the data, none were so well defined nor were they so well related between signals as in this case. Comparing the ionospheric layers to a cloud whose features are constantly changing, it was not surprising to see the phenomenon confined to a short period of time. Likewise, the irregular features of the ionosphere would allow several patterns to occur at once, superimposed on each other to create the overall observed effect. Some of these secondary features seem to show through in figure 16. The third phenomenon was the simultaneous enhancement and attenuation of signals. The seemingly incompatible conditions which caused this may have only been due to multipath

effects. It is strange, however, that no such pronounced effects were observed before or after the anomaly, particularly in trace 3, and that they occurred simultaneously among the three signals. It is expected that a great number of other anomalies exist and that many of them are preserved in the BRIGHAM data. Approximately one fifth of the available data were examined and due to time limitations, only one fifth of that amount was examined with Anomaly B. Analysis with Anomaly B was particularly time consuming because only five signals could be examined at once. It is likely that other anomalies are observable with the existing programs and many others detectable with modifications and different analysis tools. Some recommendations for improving the analysis techniques are as follows:

1. Amend the Tape Load program to read the binary number of each data card and alert the operator to missing cards. A one-up numbering system to keep pace with card numbers could be used with an "if" statement to trigger an output statement when a card is discovered missing.

2. Modify the procedure for selecting data for the amplitude history traces in Anomaly B. When cards are skipped to examine long-term propagation effects, an averaging routine should be entered to remove the short term amplitude fluctuations. The presence of the short term effects tends to mask those manifested only over a longer period of time. A modification of this type was attempted

near the end of the analysis but was unsuccessful due to a lack of time needed to perfect it.

3. Incorporate a feature for backing up the tape by a variable (NAMELIST variable) number of scans. Two attempts to do this failed. In one case it was due to the fact that each scan constituted one "physical record" in length and that backspacing was based on "logical records". If accomplished, the feature would be a significant time saving addition.

4. Temporarily abandon the visual analysis approach of Anomaly B and employ statistical analysis techniques. Evaluation of the correlation between various sets of signals could be conducted rapidly and rather exhaustively on a larger computer such as the IBM 360 available at the Naval Postgraduate School. Preliminary analysis with Anomaly A might prove useful in the selection of signals for analysis and indispensable in locating the discontinuities described earlier so as to avoid misinterpreting results.

5. Use of a larger, faster computer such as the IBM 360 to load cards onto magnetic tape would significantly reduce "dead time" in an extension of this project. Over an hour was required to load a single data set onto tape with the equipment described in this report.

## GLOSSARY

1. Bin (frequency bin): A 2.8 KHz wide data sampling point. Energy present in these limits was quantized and represented in the range from 0-28 db.

2. Data set: 3597 successive sampled sweeps or scans of the receiver and preserved on punched cards of magnetic tape.

3. Dawn chorus or whistler: Interference in the audio range from storm discharges or high energy particle interaction in the ionosphere. Dawn chorus is produced around sunrise and sounds like a serenade of birds. It is a rise in frequency above about 2 KHz. Whistlers are audible decreases in frequency and are propagated from storm discharges along magnetic force lines of the earth in the range from a few hundred hertz to 20-30 KHz.

4. NAMELIST variables: Computer variables, properly specified, which can be entered or changed after the program has been compiled and is running. These variables were used to control various aspects of the program. The most used were:

ISTRT - Integer number of the leftmost or starting bin to be displayed.

IWDTH - Integer number of adjacent bins to be displayed.

NSKIP - Number of scans to be skipped over.

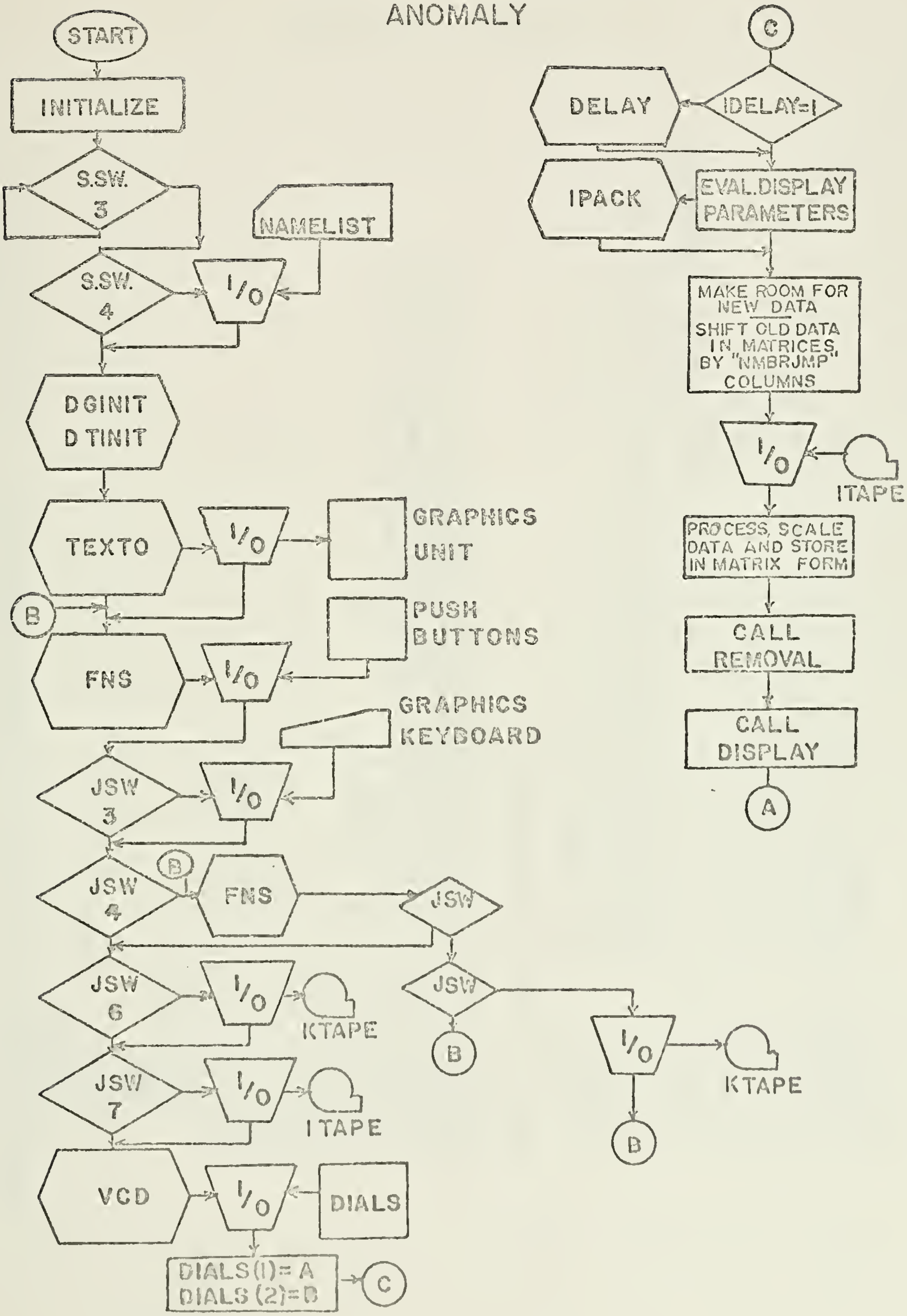
NMBRJMP - Number of scans to be brought on (and moved off) the screen at one time.

5. Scan: One sweep of the receiver from one end of the band to the other.

# PROGRAM "TAPE LOAD"

```
      DIMENSION IBUF(40),JBUF(160),KBUF(321),MASK(4),ISHT(4)
      DATA (MASK(I),I=1,4),(ISHT(I),I=1,4)/37000000B,370000B,3700B,37B,1
     18,12,6,0/
*  THIS PROGRAM RUNS WELL EXCEPT WHEN DATA CARDS HAVE AN 11-7-8 PUNCHED
*  IN CARD COLUMN 1 (SYMBOL DELTA FOR CONTROL CARD). READ-WRITE THEN
*  CEASES. TO REMEDY, PUNCH A '4' IN COL ONE OF DATA CARDS CONTAINING
*  THE ABOVE COMBINATION. THIS WILL NOT AFFECT DATA VALUES.
      RN=1
    1 DO 56 K=0,1
      CALL BUFFERIN(5,1,IBUF,40,IND)
   10 IF(IND.EQ.1) GO TO 10
      GO TO (10,20,20,100),IND
   20 N=0
      DO 50 I=1,40
      DO 40 J=1,4
   40 JBUF(N+J)=LRS(LAND(IBUF(I),MASK(J)),ISHT(J))
   50 N=N+4
      DO 55 L=1,160
   55 KBUF(K*160+1+L)=JBUF(L)
   56 CONTINUE
      KBUF(1)=NR
      NR=NR+1
      CALL BUFFEROUT(2,1,KBUF,319,IND)
   60 IF(IND.EQ.1) GO TO 60
      GO TO (60,70,70,70),IND
   70 GO TO 1
  100 OUTPUT(101)'CARD ERROR'
      PAUSE 1
      GO TO 1
 1000 CONTINUE
      PAUSE 2
      ENDFILE 2
      REWIND 2
      END
```

# GENERAL PROGRAM
# ANOMALY



PROGRAM "ANOMALY A"

```
*  REQUIRES SENSE SW. 2 AND FOL CONTROL CARDS (LEFT JUSTIFIED TO COL 1)
*        $PATCH
*        $>>DATA
*        007067  00106711
*        $END
*        ΔAGT
*        ΔJOB ANOMALY A
*        ΔFORTRAN LS,GO
      MSW(I)=LAND(ISW,LLS(1,23-I))
      JSW(I)=LAND(JW,LLS(1,23-I))
      JON(I)=LIOR(JW,LLS(1,23-I))
      JOFF(I)=LAND(JW,LXOR(-1,LLS(1,23-I)))
      INTEGER AXES(47)
      DIMENSION DIALS(6),IFILE(319)
      DIMENSION IGDIR(3),ITDIR(7)
      COMMON /AREA1/FILE(130,20),MOV(20,130),IMAGE(2700)
      COMMON /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,DX,AXES,NMBRJMP,NRSCAN
      NAMELIST IDEV,IDIAL,SCALE,SEP,NSCAN,IWDTH,ISTRT,X1,Y1,ITAPE
      NAMELIST DIALS,NMBRJMP,NSKIP,DX,IBRANCH,IDELAY
*
*     INITIALIZATION OF PARAMETERS
*
*        IDEV:     AGT NUMBER(1 OR 2)
      IDEV=1
*        IDIAL:    DIALS SAMPLED ONLY IF IDIAL=1
*                  IF NOT SAMPLED,MUST SPECIFY VALUE OF DIALS(1)+ (2)
      IDIAL=1
*        IBRANCH:  CALCULATES,SCALES DIST BETWEEN FREQ BINS IF IBRANCH=0
      IBRANCH=0
*                  IF IBRANCH.NE.0, MUST SPECIFY WIDTH(DX)
      DX=.024
*        SCALE:    DIVISOR FOR SCALING DOWN SIGNAL AMPLITUDES
      SCALE=75.
*        SEP:      SEPARATION (VERTICAL) BETWEEN SCANS
      SEP=.12
```

```
*      X1,Y1:    LOCATION OF ORIGIN ON SCREEN
      X1=-1.3
      Y1=-1.1
*      ITAPE:    TAPE NUMBER FOR DATA INPUT
      ITAPE=1
*      KTAPE:    TAPE NUMBER FOR OUTPUT OF PICTURE DATA
      KTAPE=2
*      NSCAN:    NR OF SCANS TO BE SHOWN AT ONCE
      NSCAN=20
*      IWDTH:    NR BINS (WIDTH) TO BE SHOWN AT ONCE
      IWDTH=100
*      ISTRT:    NR OF LEFTMOST BIN TO BE DISPLAYED
      ISTRT=1
*      NMBRJMP:  NR NEW SCANS BROUGHT ONTO SCREEN FOR EACH NEW PIC
      NMBRJMP=3
*      NSKIP:    NR SCANS SKIPPED(WHEN=1,DISPLAYS EVERY OTHER SCAN)
      NSKIP=0
*      IDELAY:   NUMBER OF SECONDS EXTRA DELAY BETWEEN PICTURES
      IDELAY=0
      NULL=-1
      PI=3.14159265
*
*
      OUTPUT(101)'BEGIN PROGRAM.PUSH SENSESWITCH(3) TO CONTINUE'
1     IF(SENSESWITCH(3)) 2,1
2     IF(SENSESWITCH(4)) 3,4
3     INPUT(5)
4     CALL DGINIT(IDEV,IGDIR,3,IER)
      IF(IER.NE.0) OUTPUT(101)IER,'DGINIT ERR'
      CALL DTINIT(IDEV,ITDIR,7,IER)
      IF(IER.NE.0) OUTPUT(101)IER,'DTINIT ERR'
      CALL TEXTO(IDEV,NULL,1,40,75,2,3,IER)
      IF(IER.NE.0)OUTPUT(101),'NRSCAN NULL ERR'
8     MSCAN=NSCAN
*
```

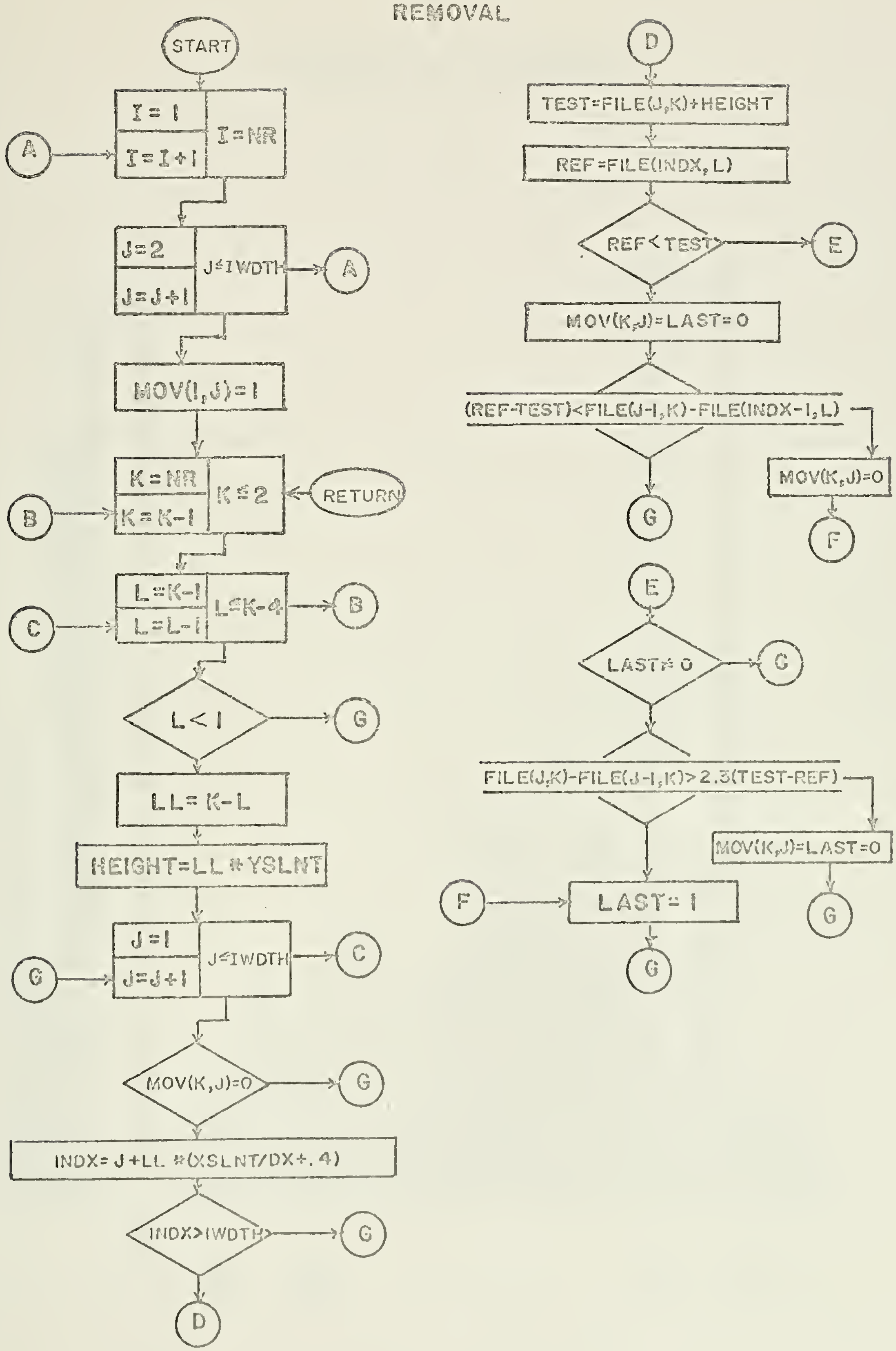
```
*     SAMPLE FUNCTION SWITCHES
*         JSW(3) = NAMELIST INPUT
*         JSW(4) = LOOP (HOLDS NEXT PICTURE)
*         JSW(5) = LOOP BREAKER (ADVANCE AUTOMATICALLY)
*         JSW(6) = WRITES AXIS AND SCAN DATA ON KTAPE FM CURRENT PICTURE
*         JSW(7) = WRITES END OF FILE (EOF) ON DATA OUTPUT TAPE (=2)
*         JSW(8) = REWINDS DATA TAPE
       CALL FNS(IDEV,ISW,IER)
       IF(IER.NE.0)OUTPUT(101)IER,'FNS ERR'
       JW=LXOR(JW,ISW)
*
*     FOL ROUTINE(TO 11) WRITES JSW NRS(3 OR 4) ON SCREEN WHEN ACTIVE
*
       LB=1
       DO 10 I=3,4
       IF(JSW(I).EQ.0)GO TO 10
       ENCODE(4,9,ITXT)I
9      FORMAT(I1)
       CALL TEXTO(IDEV,ITXT,1,LB,1,1,3,IER)
       IF(IER.NE.0)OUTPUT(101)IER,'JSW'
       LB=LB+1
10     CONTINUE
       DO 11 I=LB,2
       CALL TEXTO(IDEV,NULL,1,I,1,1,3,IER)
11     IF(IER.NE.0)OUTPUT(101)IER,'JSW NULL'
       IF(JSW(3).EQ.0)GO TO 12
       IBLK=4
       CALL GINPUT(IDEV,ITDIR,IBLK)
*
*     GINPUT WITH GINP ALLOWS NAMELIST INPUT AT AGT
*
       JW=JOFF(3)
12     IF(JSW(4).EQ.0)GO TO 17
13     CALL FNS(IDEV,ISW,IER)
       IF(IER.NE.0)OUTPUT(101)IER,'FNS1 ERR'
```

```
      JW=LXOR(JW,ISW)
      IF(JSW(5).NE.0)JW=JOFF(4);JW=JOFF(5);GO TO 17
15    IF(JSW(6).NE.0)GO TO 95
      GO TO 13
17    IF(JSW(7).NE.0)ENDFILE KTAPE;JW=JOFF(7)
      IF(JSW(8).NE.0)REWIND 1;JW=JOFF(8)
*
*    SAMPLE CONTROL DIALS
*
*       DIAL(1) = ANGLE OF Z AXIS
*       DIAL(2) = CURSOR POSITION
30    IF(IDIAL.NE.1)GO TO 35
      CALL VCD(1,DIALS,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'DIALS'
*
*    EVALUATE DISPLAY PARAMETERS
*
35    CONTINUE
      IF(IDELAY.EQ.0)GO TO 36
      IA=IDELAY*100000
      CALL DELAY
36    ISTOP=ISTRT+IWDTH-1
      WIDTH=IWDTH
      NALFA=NMBRJMP+1
      IF(IBRANCH.EQ.1)GO TO 40
      DX=2.4/WIDTH
40    IANGL=90*DIALS(1)
      ANGL=IANGL*PI/180
      Z=(NSCAN-1)*SEP
      ZX=Z*SIN(ANGL)
      ZY=Z*COS(ANGL)
      XSLNT=SEP*SIN(ANGL)
      YSLNT=SEP*COS(ANGL)
*
*    FORMAT AND PACK AXIS DATA INTO AXES ARRAY
```

```
      AXES(1)=IHEAD(0,5)
*     Y AXIS
      AXES(2)=IPACK(X1,Y1+Z,0)
      AXES(3)=IPACK(X1,Y1,1)
*     X AXIS
      AXES(4)=IPACK(X1+2.45,Y1,1)
      AXES(5)=IPACK(X1,Y1,0)
*     Z AXIS
      AXES(6)=IPACK((X1+ZX),(Y1+ZY),1)
*     X AXIS SCALE MARKS
      DØ 45 I=2,26,2
      II=I+5
      IF(I*5.GT.IWDTH)AXES(II)=AXES(II+1)=0;GØ TØ 45
      AXES(II)=IPACK(X1+I*5*DX,Y1-.03,0)
      AXES(II+1)=IPACK(X1+I*5*DX,Y1+.02,1)
45    CØNTINUE
*     Y AXIS SCALE MARKS
      DØ 46 I=2,12,2
      II=I+31
      AXES(II)=IPACK(X1-.02,Y1+(2.5/SCALE)*I,0)
      AXES(II+1)=IPACK(X1+.01,Y1+(2.5/SCALE)*I,1)
46    CØNTINUE
*     CURSØR
      AXES(45)=IPACK(DIALS(2)*DX*100-.3,Y1-.02,0)
      AXES(46)=IPACK(DIALS(2)*DX*100-.3+ZX,Y1+ZY,1)
      AXES(47)=0
      DØ 50 I=1,NSCAN
50    MØV(I,1)=0
*
*     BRING IN NEW SCANS, MØVE ØFF ØLD SCANS
*
      DØ 60 I=NSCAN,NALFA,-1
      DØ 60 J=1,IWDTH
      MØV(I,J)=MØV((I-NMBRJMP),J)
60    FILE(J,I)=FILE(J,(I-NMBRJMP))
```

```
      IF(NSCAN.GE.MSCAN)GO TO 65
*
*     ZERO OUT THAT PORTION OF *FILE* NOT BEING USED
      DO 61 I=NSCAN+1,MSCAN
      DO 61 J=ISTRT,ISTOP
61    FILE(J,I)=0
*
*     READ DATA FROM TAPE
*
65    DO 72 N=1,NMBRJMP
      IF(NSKIP.EQ.0)GO TO 66
      DO 66 J=1,NSKIP
66    CALL BUFFERIN(ITAPE,1,IFILE(1),319,IND)
70    IF(IND.EQ.1)GO TO 70
      GO TO (70,71,90,71)IND
71    DO 72 I=ISTRT,ISTOP
      FILE((I-ISTRT+1),(NALFA-N))=IFILE(I+1)/SCALE
*    NRSCAN=SCAN NR TO BE DISPLAYED ON SCREEN
72    NRSCAN=IFILE(1)
      CALL REMOVAL(NSCAN,IWDTH)
      CALL DISPLAY(NSCAN,IWDTH)
      GO TO 8
90    OUTPUT(101),'END OF DATA TAPE'
*
*    OUTPUT DATA FOR PLOTTING GRAPH
*    (MUST FIRST BE PROCESSED BY ANOMALY PLOT A FROM THIS TAPE)
*
95    CALL BUFFEROUT(KTAPE,1,AXES,44,IND)
96    IF(IND.EQ.1)GO TO 96
      CALL BUFFEROUT(KTAPE,1,IMAGE,2700,IND)
97    IF(IND.EQ.1)GO TO 97
      JW=JOFF(6)
      GO TO 13
      END
```

SUBROUTINE
REMOVAL



# SUBROUTINE "REMOVAL"

```
      SUBRØUTINE REMØVAL(NSCAN,IWDTH)
      INTEGER AXES(47)
      CØMMØN /AREA1/FILE(130,20),MØV(20,130),IMAGE(2700)
      CØMMØN /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,DX,AXES,NMBRJMP,NRSCAN
*
*  THIS SUBRØUTINE ERASES LINE SEGMENTS HIDDEN BEHIND ØTHER LINES
*
      LAST=0
105   NR=NSCAN
      DØ 110 I=1,NR
      DØ 110 J=2,IWDTH
110   MØV(I,J)=1
130   DØ 140 K=NR,2,-1
      DØ 140 L=K-1,K-4,-1
      IF(L.LT.1)GØ TØ 140
      LL=K-L
      HEIGHT=LL*YSLNT
      DØ 140 J=1,IWDTH
      IF(MØV(K,J).EQ.0)GØ TØ 140
      INDX=J+LL*(XSLNT/DX+0.4)
      IF(INDX.GT.IWDTH)GØ TØ 140
      TEST=FILE(J,K)+HEIGHT
      REF=FILE(INDX,L)
      IF(REF.LT.TEST)GØ TØ 138
      MØV(K,J)=LAST=0
137   IF(REF-TEST.LT.FILE(J-1,K)-FILE(INDX-1,L))MØV(K,J)=1;GØ TØ 139
      GØ TØ 140
138   IF(LAST.NE.0)GØ TØ 140
      IF(FILE(J,K)-FILE(J-1,K).GT.TEST-REF)MØV(K,J)=LAST=0;GØ TØ 140
139   LAST=1
140   CØNTINUE
      RETURN
      END
```

## SUBROUTINE "DISPLAY"

```
      SUBRØUTINE DISPLAY(NSCAN,IWDTH)
      INTEGER AXES(47)
      CØMMØN /AREA1/FILE(130,20),MØV(20,130),IMAGE(2700)
      CØMMØN /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,DX,AXES,NMBRJMP,NRSCAN
*
*  THIS SUBRØUTINE PACKS DATA INTØ PRØPER FØRMAT FØR GRAPHICS UNIT
*
200   N=1
      IMAGE(1)=IHEAD(0,10)
      DØ 210 I=1,NSCAN
      X=X1+XSLNT*(I-1)
      Y=Y1+YSLNT*(I-1)
      DØ 210 J=1,IWDTH
      N=N+1
      M=MØV(I,J)
      EX=X+DX*(J-1)
      WYE=Y+FILE(J,I)
      IF(EX.GT.1.3)M=0
210   IMAGE(N)=IPACK(EX,WYE,M)
      DØ 211 I=N+1,2700
211   IMAGE(I)=0
      CALL GRAPHØ(IDEV,AXES,47,1,IER)
      IF(IER.NE.0)ØUTPUT(101)IER,'AXES ERR'
      CALL GRAPHØ(IDEV,IMAGE,2700,2,IER)
      IF(IER.NE.0)ØUTPUT(101),'IMAGERR'
      ENCØDE(4,220,JTXT)NRSCAN
220   FØRMAT(I4)
      CALL TEXTØ(IDEV,JTXT,1,40,75,2,3,IER)
      IF(IER.NE.0)ØUTPUT(101)IER,'NRSCAN ERR'
      RETURN
      END
```

The following subroutines, GINP, GINPUT, FNS and VCD, are common to and required by both programs Anomaly A and Anomaly B. They are library subroutines but are nonstandard and subject to change.

## SUBROUTINE "GINP"

```
      SUBROUTINE GINP(IDEV,ITDIR,IBLK,IBUF)
      DIMENSION IBUF(1),ITDIR(1)
*
*  THIS SUBROUTINE CALLED BY GINPUT FOR NAMELIST INPUT AT AGT
*
      IB=IBLK+1
      NULL=-1
      IF(IBUF(1))1,50,100
1     IF(IBUF(1).NE.-1)GO TO 100
      ENCODE(16,10,IBUF)
10    FORMAT('NAMELIST INPUT')
      CALL TEXTO(IDEV,IBUF,4,38,1,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'GINP1'
      RETURN
50    CALL TEXTO(IDEV,NULL,1,38,1,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'NULL1'
      CALL TEXTO(IDEV,NULL,1,40,4,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'NULL2'
      RETURN
100   CALL TEXTR(IDEV,NULL,1,40,4,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'GINP2'
110   IF(MOD(ITDIR(IB),8).EQ.0)GO TO 110
      CALL TEXTI(IDEV,IBUF,24,0,IB,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'GINP3'
      RETURN
      END
```

SUBROUTINE "GINPUT"

(METASYMBOL)

```
$GINPUT PZE     0
        BRM     9SETUPN
        PZE     3
IDEV    PZE     0
ITDIR   PZE     0
IBLK    PZE     0
        LDP     IDEV
        STD     TEXTØ+3
        LDA     *IBLK
        STA     BLØCK
        LDA     INPADR
        ADD     BUF
        STA     IBUF
        LDA     R\ØNES
        STA     *IBUF
        BRM     TEXTØ
        PZE     0
        LDA     INPADR
        ADD     READ
        STA     PATCH
        LDA     BRM
        XMA     *PATCH
        STA     BRM
        LDA     =101
        STA     *IBUF
INPADR  BRM     9INPUT
        STZ     *IBUF
        BRM     TEXTØ
        PZE     0
        LDA     BRM
        XMA     *PATCH
        STA     BRM
        BRR     GINPUT
```

```
*
TEXTØ   PZE     0
        BRM     GINP
        PZE     4
        PZE     0
        PZE     0
        PZE     BLØCK
IBUF    PZE     0
        MPØ     TEXTØ
        BRR     TEXTØ
*
*
*
BLØCK   PZE     0
PATCH   PZE     0
BRM     BRM     TEXTØ
READ    DATA    0563
BUF     DATA    0773
        END
```

SUBROUTINE "FNS"

(METASYMBOL)

```
$FNS    PZE     0
        BRM     9SETUPN
        PZE     3
IDEV    PZE     0
ISW     PZE     0
IER     PZE     0
        LDA     *IDEV
        BRM     DVN9CK
        BRU     FNSDER
        STA     FNSCL+2
        STA     FI9BFL
        LDA     =01000000
        STA     FNSSW9
        EBM     032004
FNSCL   BRM     D\EXEC
        PZE     2
        PZE     0
        PZE     FNSSW9
        EBM     032001
        EBM     032002
        LDA     *IDEV
        SKA     I9BFL
        BRU     $-1
        SKE     =1
        BRU     $+3
        LDA     077766
        BRU     $+2
        LDA     077771
        STA     *ISW
        LDA     =0
        BRU     $+2
FNSDER  LDA     =1
FNSER   STA     *IER
        BRR     FNS
FNSSW9  PZE     0
```

```
PZE       0
PZE       0
END
```

SUBROUTINE "VCD"

(METASYMBOL)

```
$VCD    PZE     0
        LDA     VCD
        STA     JSB
        LDA     =077777
        STA     VCD
        BRU     $+2
$JSB    PZE     0
        BRM     9SETUPN
        PZE     3
AGTNØ   PZE     0
PØTS    PZE     0
EFLG    PZE     0
        STX     SAVE,1
JSB1    LDA     *AGTNØ
        BRM     DVNØCK          IS AGT NØ ØK
        BRU     JSBDER          NØ
       STA      FIØBFL
        STA     JSBCL+2         YES,SAVE IT
        LDB     =02000000       CØMMAND CØDE 2 IF JSB
        LDA     VCD
        SKU     =077777
        LDB     =03000000       CØDE 3 IF VCD
        STB     JSBSWØ          STØRE CØDE IN SWØ 1
        LDA     =077750
        STA     JSBSWØ+1        SAVE IN SWØ 1
        EØM     032004
JSBCL   BRM     D\EXEC
        PZE     2
        PZE     0
        PZE     JSBSWØ
        EØM     032001
        EØM     032002
        LDA     *AGTNØ
        SKA     IØBFL
        BRU     $-1
```

```
        LDA     =0
        BRU     JSBER
JSBDER  LDA     =1
JSBER   STA     *EFLG
        LDX     =0177775,1
        LDA     VCD
        SKU     =077777
        LDX     =0177772,1
AGIN    LDA     *JSBSW8+1
        LDB     =0
        FLA     QQ
        STD     *P8TS
        MPT     P8TS
        MP8     JSBSW8+1
        BRX     AGIN,1
        STZ     VCD
        LDX     SAVE,1
        BRR     JSB
SAVE    PZE     0
JSBSW8  PZE     0
        PZE     0
        PZE     0
QQ      PZE     0
        PZE     0
        END
```

PROGRAM "ANOMALY B"

```
*  REQUIRES SENSE SW. 2 AND FØL CØNTRØL CARDS (LEFT JUSTIFIED TØ CØL 1)
*       $PATCH
*       $>>DATA
*       007067  00106711
*       $END
*       ΔAGT
*       ΔJØB ANØMALY B
*       ΔFØRTRAN LS,GØ
      MSW(I)=LAND(ISW,LLS(1,23-I))
      JSW(I)=LAND(JW,LLS(1,23-I))
      JØN(I)=LIØR(JW,LLS(1,23-I))
      JØFF(I)=LAND(JW,LXØR(-1,LLS(1,23-I)))
      INTEGER AXES(113)
      DIMENSIØN DIALS(6),IFILE(319),AVECTR(405)
      DIMENSIØN IGDIR(4),ITDIR(7)
      CØMMØN /AREA1/FILE(318,5),MØV(5,318),IMAGE(1591),AMPHIST(5,81)
      CØMMØN /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,Y2,DX,AXES,NMBRJMP,NRSCAN
      CØMMØN /AREA3/JMAGE(406),SCALE2,IBIN1,IBIN2,IBIN3,IBIN4,IBIN5
      EQUIVALENCE (AMPHIST(1,1),AVECTR(1))
      NAMELIST IDEV,IDIAL,SCALE,SEP,NSCAN,IWDTH,ISTRT,X1,Y1,ITAPE,Y2
      NAMELIST DIALS,NMBRJMP,NSKIP,IDELAY,DX,IBRANCH
      NAMELIST IBIN1,IBIN2,IBIN3,IBIN4,IBIN5,SCALE2
*
*    INITIALIZATIØN ØF PARAMETERS
*
*        IDEV:     AGT NUMBER(1 ØR 2)
      IDEV=1
*        IDIAL:    DIALS SAMPLED ØNLY IF IDIAL=1
*                  IF NØT SAMPLED,MUST SPECIFY VALUE ØF DIALS(1)+ (2)
      IDIAL=1
*        IBRANCH:  CALCULATES,SCALES DIST BETWEEN FREQ BINS IF IBRANCH=0
      IBRANCH=0
*                  IF IBRANCH.NE.0, MUST SPECIFY WIDTH(DX)
      DX=.024
*        SCALE:    DIVISØR FØR SCALING DØWN SIGNAL AMPLITUDES
```

```
      SCALE=125.
*        SCALE2:   DIVISØR FØR SCALING DØWN AMPHIST TRACES SEPARATELY
      SCALE2=120.0
*        SEP:      SEPARATIØN (VERTICAL) BETWEEN SCANS
      SEP=.11
*        X1,Y1,Y2: LØCATIØN ØF ØRIGIN ØN SCREEN
      X1=-1.3
      Y1=-1.1
      Y2=1.1
*        ITAPE:    TAPE NUMBER FØR DATA INPUT
      ITAPE=1
*        KTAPE:    TAPE NUMBER FØR ØUTPUT ØF PICTURE DATA
      KTAPE=2
*        NSCAN:    NR ØF SCANS TØ BE SHØWN AT ØNCE
      NSCAN=5
*        IWDTH:    NR BINS (WIDTH) TØ BE SHØWN AT ØNCE
      IWDTH=318
*        ISTRT:    NR ØF LEFTMØST BIN TØ BE DISPLAYED
      ISTRT=1
*        NMBRJMP:  NR NEW SCANS BRØUGHT ØNTØ SCREEN FØR EACH NEW PIC
      NMBRJMP=3
*        NSKIP:    NR SCANS SKIPPED(WHEN=1,DISPLAYS EVERY ØTHER SCAN)
      NSKIP=0
*        IDELAY:   NUMBER ØF SECØNDS EXTRA DELAY BETWEEN PICTURES
      IDELAY=0
*        IBIN:     BIN NR ØF SIGNAL TØ BE VIEWED IN AMPHIST TRACES
      IBIN1=2
      IBIN5=IBIN4=IBIN3=IBIN2=IBIN1
      NULL=-1
*        AVFCTR:   AVERAGING FACTØR,USED TØ CALC AMPHIST WHEN NSKIP.GT.1
      AVFCTR6=AVFCTR7=AVFCTR8=AVFCTR9=AVFCT10=0.0
      PI=3.14159265
*
*
      ØUTPUT(101)'BEGIN PRØGRAM.PUSH SENSESWITCH(3) TØ CØNTINUE'
```

```
1       IF(SENSESWITCH(3)) 2,1
2       IF(SENSESWITCH(4)) 3,4
3       INPUT(5)
4       CALL DGINIT(IDEV,IGDIR,3,IER)
        IF(IER.NE.0) OUTPUT(101)IER,'DGINIT ERR'
        CALL DTINIT(IDEV,ITDIR,7,IER)
        IF(IER.NE.0) OUTPUT(101)IER,'DTINIT ERR'
        CALL TEXTO(IDEV,NULL,1,40,75,2,3,IER)
        IF(IER.NE.0)OUTPUT(101),'NRSCAN NULL ERR'
8       MSCAN=NSCAN
*
*      SAMPLE FUNCTION SWITCHES
*          JSW(3) = NAMELIST INPUT
*          JSW(4) = LOOP (HOLDS NEXT PICTURE)
*          JSW(5) = LOOP BREAKER (ADVANCE AUTOMATICALLY)
*          JSW(6) = WRITES AXIS AND SCAN DATA ON KTAPE FM CURRENT PICTURE
*          JSW(7) = WRITES END OF FILE (EOF) ON DATA OUTPUT TAPE
*          JSW(8) = REWINDS DATA TAPE
*          JSW(9) = ZEROES OUT AMPLITUDE HISTORY DISPLAY
        CALL FNS(IDEV,ISW,IER)
        IF(IER.NE.0)OUTPUT(101)IER,'FNS ERR'
        JW=LXOR(JW,ISW)
*
*      FSL ROUTINE(TO 11) WRITES JSW NRS(3 OR 4) ON SCREEN WHEN ACTIVE
*
        LB=1
        DO 10 I=3,4
        IF(JSW(I).EQ.0)GO TO 10
        ENCODE(4,9,ITXT)I
9       FORMAT(I1)
        CALL TEXTO(IDEV,ITXT,1,LB,1,1,3,IER)
        IF(IER.NE.0)OUTPUT(101)IER,'JSW'
        LB=LB+1
10      CONTINUE
        DO 11 I=LB,2
```

```
      CALL TEXT8(IDEV,NULL,1,I,1,1,3,IER)
11    IF(IER.NE.0)8UTPUT(101)IER,'JSW NULL'
      IF(JSW(3).EQ.0)G8 T8 12
      IBLK=4
      CALL GINPUT(IDEV,ITDIR,IBLK)
*
*    GINPUT WITH GINP ALL8WS NAMELIST INPUT AT AGT
*
      JW=J8FF(3)
12    IF(JSW(4).EQ.0)G8 T8 17
13    CALL FNS(IDEV,ISW,IER)
      IF(IER.NE.0)8UTPUT(101)IER,'FNS1 ERR'
      JW=LX8R(JW,ISW)
      IF(JSW(5).NE.0)JW=J8FF(4);JW=J8FF(5);G8 T8 17
15    IF(JSW(6).NE.0)G8 T8 95
      G8 T8 13
17    IF(JSW(7).NE.0)ENDFILE KTAPE;JW=J8FF(7)
      IF(JSW(8).NE.0)REWIND 1;JW=J8FF(8)
      IF(JSW(9).EQ.0)G8 T8 30
      D8 18 I=1,405
18    AVECTR(I)=0
      JW=J8FF(7)
*
*    SAMPLE C8NTR8L DIALS
*
*       DIAL(1) = ANGLE 8F Z AXIS
*       DIAL(2) = CURS8R P8SITI8N
30    IF(IDIAL.NE.1)G8 T8 35
      CALL VCD(1,DIALS,IER)
      IF(IER.NE.0)8UTPUT(101)IER,'DIALS'
*
*    EVALUATE DISPLAY PARAMETERS
*
35    C8NTINUE
      IF(IDELAY.EQ.0)G8 T8 36
```

```
      IA=IDELAY*100000
      CALL DELAY
36    ISTOP=ISTRT+IWDTH-1
      WIDTH=IWDTH
      NALFA=NMBRJMP+1
      IF(IBRANCH.EQ.1)GO TO 40
      DX=2.15/WIDTH
40    IANGL=90*DIALS(1)
      ANGL=IANGL*PI/180
      Z=(NSCAN-1)*SEP
      ZX=Z*SIN(ANGL)
      ZY=Z*COS(ANGL)
      XSLNT=SEP*SIN(ANGL)
      YSLNT=SEP*COS(ANGL)
*
*    FORMAT AND PACK AXIS DATA INTO AXES ARRAY
*
      AXES(1)=IHEAD(0,4)
*    Y AXIS
      AXES(2)=IPACK(X1,Y1+Z,0)
      AXES(3)=IPACK(X1,Y1,1)
*    X AXIS
      AXES(4)=IPACK(X1+2.45,Y1,1)
      AXES(5)=IPACK(X1,Y1,0)
*    Z AXIS
      AXES(6)=IPACK((X1+ZX),(Y1+ZY),1)
*    X AXIS SCALE MARKS
      DO 45 I=2,64,2
      II=I+5
      IF(I*5.GT.IWDTH)AXES(II)=AXES(II+1)=0;GO TO 45
      AXES(II)=IPACK(X1+I*5*DX,Y1-.03,0)
      AXES(II+1)=IPACK(X1+I*5*DX,Y1+.02,1)
45    CONTINUE
*    Y AXIS SCALE MARKS
      DO 46 I=2,6,2
```

```
      II=I+69
      AXES(II)=IPACK(X1-.02,Y1+(5.0/SCALE)*I,0)
      AXES(II+1)=IPACK(X1+.01,Y1+(5.0/SCALE)*I,1)
46    CONTINUE
*    AXES AND SCALE MARKS FOR TRACES AT TOP OF PICTURE
      AXES(77)=IPACK(X1-.02,Y2,0)
      AXES(78)=IPACK(X1+.01,Y2,1)
      L=0
      DO 48 I=2,30,2
      L=L+2
      II=I+77
      AXES(II)=IPACK(X1-.02,Y2-(5.0/SCALE2)*I,0)
      IF(L.EQ.6)L=0;GO TO 47
      AXES(II+1)=IPACK(X1+.01,Y2-(5.0/SCALE2)*I,1)
      GO TO 48
47    AXES(II+1)=IPACK(X1+2.3,Y2-(5.0/SCALE2)*I,1)
48    CONTINUE
      AXES(109)=IPACK(X1,Y2,0)
      AXES(110)=IPACK(X1,Y2-(5.0/SCALE2)*30,1)
*    CURSOR
      AXES(111)=IPACK(DIALS(2)*DX*100-.3,Y1-.02,0)
      AXES(112)=IPACK(DIALS(2)*DX*100-.3+ZX,Y1+ZY,1)
      AXES(113)=0
      DO 50 I=1,NSCAN
50    MOV(I,1)=0
*
*     SHIFT SCANS UPWARD NMBRJMP POSITIONS
*
      DO 55 I=1,5
      AMPHIST(I,81)=0
      DO 55 J=80,NALFA,-1
55    AMPHIST(I,J)=AMPHIST(I,J-NMBRJMP)
      DO 60 I=NSCAN,NALFA,-1
      DO 60 J=1,IWDTH
      MOV(I,J)=MOV((I-NMBRJMP),J)
```

```
60     FILE(J,I)=FILE(J,(I-NMBRJMP))
       IF(NSCAN.GE.MSCAN)GO TO 65
*
*     ZERO OUT THAT PORTION OF *FILE* NOT BEING USED
*
       DO 61 I=NSCAN+1,MSCAN
       DO 61 J=ISTRT,ISTOP
61     FILE(J,I)=0
*
*     READ DATA FROM TAPE
*
65     DO 76 N=1,NMBRJMP
       IF(NSKIP.EQ.0)GO TO 66
       DO 66 J=1,NSKIP
66     CALL BUFFERIN(ITAPE,1,IFILE(1),319,IND)
70     IF(IND.EQ.1)GO TO 70
       GO TO (70,71,90,71)IND
71     DO 72 I=ISTRT,ISTOP
       FILE((I-ISTRT+1),(NALFA-N))=IFILE(I+1)/SCALE
*     NRSCAN=SCAN NR TO BE DISPLAYED ON SCREEN
72     NRSCAN=IFILE(1)
*
*     PICK MAX OF 3 BINS FOR AMPHIST VALUE (CENTER AT IBIN+1)
*
       NN=NALFA-N
       AMPHIST(1,NN)=AMAX(IFILE(IBIN1),IFILE(IBIN1+1),IFILE(IBIN1+2))/SCA
      1LE
       AMPHIST(2,NN)=AMAX(IFILE(IBIN2),IFILE(IBIN2+1),IFILE(IBIN2+2))/SCA
      1LE
       AMPHIST(3,NN)=AMAX(IFILE(IBIN3),IFILE(IBIN3+1),IFILE(IBIN3+2))/SCA
      1LE
       AMPHIST(4,NN)=AMAX(IFILE(IBIN4),IFILE(IBIN4+1),IFILE(IBIN4+2))/SCA
      1LE
76     AMPHIST(5,NN)=AMAX(IFILE(IBIN5),IFILE(IBIN5+1),IFILE(IBIN5+2))/SCA
      1LE
```

```
      CALL REMOVAL(NSCAN,IWDTH)
      CALL DISPLAY(NSCAN,IWDTH)
      GO TO 8
90    OUTPUT(101),'END OF DATA TAPE'
*
*    OUTPUT DATA FOR PLOTTING GRAPH
*    (MUST FIRST BE PROCESSED BY ANOMALY PLOT B FROM THIS TAPE)
*
95    CALL BUFFEROUT(KTAPE,1,AXES,110,IND)
96    IF(IND.EQ.1)GO TO 96
      CALL BUFFEROUT(KTAPE,1,IMAGE,1591,IND)
97    IF(IND.EQ.1)GO TO 97
      CALL BUFFEROUT(2,1,JMAGE,406,IND)
98    IF(IND.EQ.1)GO TO 98
      JW=JSFF(6)
      GO TO 13
      END
```

# SUBROUTINE "REMOVAL"

```
      SUBROUTINE REMOVAL(NSCAN,IWDTH)
      INTEGER AXES(113)
      COMMON /AREA1/FILE(318,5),MOV(5,318),IMAGE(1591),AMPHIST(5,81)
      COMMON /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,Y2,DX,AXES,NMBRJMP,NRSCAN
      COMMON /AREA3/JMAGE(406),SCALE2,IBIN1,IBIN2,IBIN3,IBIN4,IBIN5
*
*  THIS SUBROUTINE ERASES LINE SEGMENTS HIDDEN BEHIND OTHER LINES
*
      LAST=0
105   NR=NSCAN
      DO 110 I=1,NR
      DO 110 J=2,IWDTH
110   MOV(I,J)=1
130   DO 140 K=NR,2,-1
      DO 140 L=K-1,K-4,-1
      IF(L.LT.1)GO TO 140
      LL=K-L
      HEIGHT=LL*YSLNT
      DO 140 J=1,IWDTH
      IF(MOV(K,J).EQ.0)GO TO 140
      INDX=J+LL*(XSLNT/DX+.4)
      IF(INDX.GT.IWDTH)GO TO 140
      TEST=FILE(J,K)+HEIGHT
      REF=FILE(INDX,L)
      IF(REF.LT.TEST)GO TO 138
      MOV(K,J)=LAST=0
137   IF(REF-TEST.LT.FILE(J-1,K)-FILE(INDX-1,L))MOV(K,J)=1;GO TO 139
      GO TO 140
138   IF(LAST.NE.0)GO TO 140
      IF(FILE(J,K)-FILE(J-1,K).GT.TEST-REF)MOV(K,J)=LAST=0;GO TO 140
139   LAST=1
140   CONTINUE
      RETURN
      END
```

## SUBROUTINE "DISPLAY"

```
      SUBRØUTINE DISPLAY(NSCAN,IWDTH)
      INTEGER AXES(113)
      CØMMØN /AREA1/FILE(318,5),MØV(5,318),IMAGE(1591),AMPHIST(5,81)
      CØMMØN /AREA2/IDEV,XSLNT,YSLNT,X1,Y1,Y2,DX,AXES,NMBRJMP,NRSCAN
      CØMMØN /AREA3/JMAGE(406),SCALE2,IBIN1,IBIN2,IBIN3,IBIN4,IBIN5
*
*  THIS SUBRØUTINE PACKS DATA INTØ PRØPER FØRMAT FØR GRAPHICS UNIT
*
      BX=2.3/80.0
200   N=1
      IMAGE(1)=IHEAD(0,10)
      DØ 210 I=1,NSCAN
      X=X1+XSLNT*(I-1)
      Y=Y1+YSLNT*(I-1)
      DØ 210 J=1,IWDTH
      N=N+1
      M=MØV(I,J)
      EX=X+DX*(J-1)
      WYE=Y+FILE(J,I)
      IF(EX.GT.1.3)M=0
210   IMAGE(N)=IPACK(EX,WYE,M)
      DØ 211 I=N+1,1591
211   IMAGE(I)=0
      N=1
      JMAGE(1)=IHEAD(0,10)
      DØ 215 I=1,5
      DØ 215 J=1,81
      N=N+1
      EX=X1+BX*(J-1)
      WHY=Y2+AMPHIST(I,J)-(30.0/SCALE2)*I
      JMAGE(N)=IPACK(EX,WHY,1)
215   IF(J.EQ.1)JMAGE(N)=IPACK(EX,WHY,0)
      JMAGE(82)=JMAGE(163)=JMAGE(244)=JMAGE(325)=JMAGE(406)=0
      CALL GRAPH9(IDEV,AXES,113,1,IER)
      IF(IER.NE.0)ØUTPUT(101)IER,'AXES ERR'
```

```
      CALL GRAPHØ(IDEV,IMAGE,1591,2,IER)
      IF(IER.NE.0)ØUTPUT(101),'IMAGERR'
      CALL GRAPHØ(IDEV,JMAGE,406,3,IER)
      IF(IER.NE.0)ØUTPUT(101)'AMPHIST ERR'
      ENCØDE(4,220,JTXT)NRSCAN
220   FØRMAT(I4)
      CALL TEXTØ(IDEV,JTXT,1,40,75,2,3,IER)
      IF(IER.NE.0)ØUTPUT(101)IER,'NRSCAN ERR'
      RETURN
      END
```

# PROGRAM "ANOMALY PLOT A"

```
      DIMENSIØN IBUF(2700),X(150),Y(150),ITITLE(24),IXY(100,20),ISUB(12)
      EQUIVALENCE (IBUF(2),IXY),(ITITLE(13),ISUB)
      NAMELIST ISIZE,IHEAD,IEND,SCALE,BIAS,JØIN
*   PLØT PARAMETERS
*    IB=4H STATEMENT REQUIRED TØ NULL ØUT TITLE LINES NØT USED
*    IHEAD=HEADER SPECIFICATIØN: 0=NØ HEADER,1=2 LINES,2=1 LINE
*    ISIZE=SIZE ØF PLØT(INCHES). ØNLY VALUES 4,8,12,16,20
*    JØIN=NR ØF PICTURES TØ BE JØINED TØ BASE PICTURE
*    SCALE=NR ØF UNITS PER INCH TØ BE PLØTTED(HIGHER NR,SMALLER PLØT)
*    BIAS=ØFFSET(VERTICAL) FØR STARTING PICTURES TØ BE JØINED
*    TAPE ASSIGNMENTS: INPUT ØN 2, ØUTPUT ØN 1
*    TITLE LINES ALLØW AT LEAST 42 CHARACTERS/SPACES PER LINE
      IB=4H
      IHEAD=0
      ISIZE=12
      JØIN=0
      SCALE=.4
      IEND=0
* NØTE   DIMENSIØNS ØF IXY MUST CØRRESPØND WITH IWDTH,NSCAN RSPY
      NSCAN=20
      IWDTH=100
      BIAS=2.4
      DØ 10 I=1,24
10    ITITLE(I)=4H
*
*   INPUT
*
20    ØUTPUT(101)'INPUT PARAMETERS'
      INPUT(101)
      IF(IEND.EQ.1) GØ TØ 600
      IW=IH=ISIZE
      XSC=YSC=SCALE
      MØDTEST=JØIN
      IF(IHEAD.EQ.1) GØ TØ 250
      IF(IHEAD.EQ.2) GØ TØ 270
```

```
25    CØNTINUE
*
*   PRØCESS AXES RECØRD
*
50    CØNTINUE
      IF(JØIN.GT.0)GØ TØ 305
      CALL BUFFERIN(2,1,IBUF,44,IND)
100   IF(IND.EQ.1) GØ TØ 100
      GØ TØ (100,101,500,200)IND
101   IF(MØDTEST.GT.0)GØ TØ 125
      CALL UNPACK(IBUF(2),X(1),Y(1),IMD)
      X(1)=X(1)+1.3
      Y(1)=Y(1)+1.1
      CALL UNPACK(IBUF(3),X(2),Y(2),IMD)
      X(2)=X(2)+1.3
      Y(2)=Y(2)+1.1
      CALL DRAW(2,X,Y,1,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
110   DØ 120 I=3,6
      II=I-2
      CALL UNPACK(IBUF(I),X(II),Y(II),IMD)
      X(II)=X(II)+1.3
      Y(II)=Y(II)+1.1
120   CØNTINUE
      CALL DRAW(4,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
      DØ 125 J=7,43,2
      CALL UNPACK(IBUF(J),X(1),Y(1),IMD)
      X(1)=X(1)+1.3
      Y(1)=Y(1)+1.1
      IF(IMD.NE.0)ØUTPUT(101)'IMD ERR'
      CALL UNPACK(IBUF(J+1),X(2),Y(2),IMD)
      X(2)=X(2)+1.3
      Y(2)=Y(2)+1.1
      IF(IMD.EQ.0)GØ TØ 125
      CALL DRAW(2,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
125   CØNTINUE
```

```
      CALL BUFFERIN(2,1,IBUF,2700,IND)
130   IF(IND.EQ.1) GØ TØ 130
      GØ TØ (130,140,500,50)IND
140   CØNTINUE
*
*   PRØCESS DATA RECØRDS
*
150   MØD=2
      JJ=0
      DØ 170 J=1,NSCAN
      DØ 160 I=1,IWDTH
      JJ=JJ+1
      CALL UNPACK(IXY(I,J),X(JJ),Y(JJ),IMD)
      X(JJ)=X(JJ)+1.3
      Y(JJ)=Y(JJ)+1.1
      IF(JJ.EQ.1) GØ TØ 160
      IF(IMD.EQ.1) GØ TØ 160
      IF(JJ.LT.3) GØ TØ 155
      CALL DRAW(JJ-1,X,Y,MØD,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
155   X(1)=X(JJ)
      Y(1)=Y(JJ)
      JJ=1
160   CØNTINUE
      IF(J.NE.NSCAN)GØ TØ 165
      IF(JØIN.LT.1) MØD=3
      ØUTPUT(101)'FINISHED ØNE PICTURE'
      IF(JJ.EQ.1)GØ TØ 169
165   CALL DRAW(JJ,X,Y,MØD,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
169   JJ=0
170   CØNTINUE
      IF(MØD.EQ.3)GØ TØ 179
      X(2)=X(1)+.01
      Y(2)=Y(1)
      CALL DRAW(2,X,Y,3,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
*
```

```
*    RUN TERMINATION OPTIONS
*
*      SENSE 5 ON,   AUTO MODE
*      SENSE 6 ON,   TERMINATION
*
179    IF(SENSE SWITCH 6) 20,180
180    IF(SENSE SWITCH 5) 25,20
*
*    SKIP BAD RECORDS
*
200    OUTPUT(101)'SKIP BAD RECORD'
       CALL BUFFERIN(2,1,IBUF,1,IND)
210    IF(IND.EQ.1) GO TO 210
       GO TO (210,50,500,50)IND
*
*    INPUT TITLE
*
250    DO 260 I=1,12
260    ITITLE(I)=4H
       OUTPUT(101)'INPUT TITLE'
       READ(101,300) ITITLE
270    DO 280 I=1,12
280    ISUB(I)=4H
       OUTPUT(101)'INPUT SUB HEADER'
       READ(101,300) ISUB
       GO TO 25
300    FORMAT(12A4)
*
*    THIS LOOP (TO 331) DRAWS PICTURES TO BE JOINED TO BASE PICTURE
*
305    CALL BUFFERIN(2,1,IBUF,44,IND)
306    IF(IND.EQ.1)GO TO 306
       GO TO (306,307,500,200)IND
307    IF(MODTEST-JOIN.GT.0)GO TO 310
       CALL UNPACK(IBUF(2),X(1),Y(1),IMD)
```

```
      X(1)=X(1)+1.3
      Y(1)=Y(1)+BIAS*J0IN+1.1
      IF(IMD.NE.0)0UTPUT(101)'IMD Y AXIS M0V ERR'
      CALL UNPACK(IBUF(3),X(2),Y(2),IMD)
      X(2)=X(2)+1.3
      Y(2)=Y(2)+1.1
      IF(IMD.NE.1)0UTPUT(101)'IMD Y AXIS DRAW ERR'
      CALL DRAW(2,X,Y,1,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
      D0 308 I=3,4
      II=I-2
      CALL UNPACK(IBUF(I),X(II),Y(II),IMD)
      X(II)=X(II)+1.3
      Y(II)=Y(II)+1.1
308   C0NTINUE
      CALL DRAW(2,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
      D0 309 J=7,43,2
      CALL UNPACK(IBUF(J),X(1),Y(1),IMD)
      X(1)=X(1)+1.3
      Y(1)=Y(1)+1.1
      IF(IMD.NE.0)0UTPUT(101)'IMD ERR'
      CALL UNPACK(IBUF(J+1),X(2),Y(2),IMD)
      X(2)=X(2)+1.3
      Y(2)=Y(2)+1.1
      IF(IMD.EQ.0)G0 T0 309
      CALL DRAW(2,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
309   C0NTINUE
*
*  PR0CESS DATA REC0RDS
*
310   CALL BUFFERIN(2,1,IBUF,2700,IND)
311   IF(IND.EQ.1)G0 T0 311
      G0 T0 (311,312,500,50)IND
312   JJ=0
      D0 330 J=1,NSCAN
      D0 320 I=1,IWDTH
```

```
      JJ=JJ+1
      CALL UNPACK(IXY(I,J),X(JJ),Y(JJ),IMD)
      X(JJ)=X(JJ)+1.3
      Y(JJ)=Y(JJ)+BIAS*JØIN+1.1
      IF(JJ.EQ.1)GØ TØ 320
      IF(IMD.EQ.1)GØ TØ 320
      IF(JJ.LT.3)GØ TØ 315
      CALL DRAW(JJ-1,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
315   X(1)=X(JJ)
      Y(1)=Y(JJ)
      JJ=1
320   CØNTINUE
325   CALL DRAW(JJ,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,0,0,IW,IH,0,LAST)
      JJ=0
330   CØNTINUE
      JØIN=JØIN-1
      IF((MØDTEST-JØIN).EQ.1)ØUTPUT(101)'FINISHED JØINING FIRST PICTURE'
      IF((MØDTEST-JØIN).EQ.2)ØUTPUT(101)'FINISHED JØINING 2ND PICTURE'
      IF(JØIN.GT.0)GØ TØ 305
      GØ TØ 50
*
*    END ØF RUN
*
500   ØUTPUT(101)'END ØF TAPE'
      REWIND 1
      GØ TØ 20
600   ØUTPUT(101)'END ØF PLØT'
      ØUTPUT(1)'END ØF PLØT'
      IEND=0
      REWIND 2
      GØ TØ 20
*
*    NEED $ CØNTRØL CARD WHEN LØADING DRAW PRØGRAM FM CARDS
*
      END
```

# PROGRAM "ANOMALY PLOT B"

```
      DIMENSIØN IBUF(1591),X(318),Y(318),ITITLE(24),IXY(318,5),ISUB(12)
      DIMENSIØN JXY(81,5)
      EQUIVALENCE (IBUF(2),IXY,JXY),(ITITLE(13),ISUB)
      NAMELIST ISIZE,IHEAD,IEND,SCALE
*    PLØT PARAMETERS
*     IB=4H STATEMENT REQUIRED TØ NULL ØUT TITLE LINES NØT USED
*     IHEAD=HEADER SPECIFICATIØN: 0=NØ HEADER,1=2 LINES,2=1 LINE
*     ISIZE=SIZE ØF PLØT(INCHES). ØNLY VALUES 4,8,12,16,20
*     SCALE=NR ØF UNITS PER INCH TØ BE PLØTTED(HIGHER NR,SMALLER PLØT)
*     TAPE ASSIGNMENTS: INPUT ØN 2, ØUTPUT ØN 1
*     TITLE LINES ALLØW AT LEAST 42 CHARACTERS/SPACES PER LINE
      IB=4H
      IHEAD=0
      ISIZE=12
      SCALE=.4
      IEND=0
* NØTE   DIMENSIØNS ØF IXY MUST CØRRESPØND WITH IWDTH,NSCAN RSPY
      NSCAN=5
      IWDTH=318
*
      DØ 10 I=1,24
10    ITITLE(I)=4H
*
20    ØUTPUT(101)'INPUT PARAMETERS'
      INPUT(101)
      IF(IEND.EQ.1) GØ TØ 600
      IW=IH=ISIZE
      XSC=YSC=SCALE
      IF(IHEAD.EQ.1) GØ TØ 250
      IF(IHEAD.EQ.2) GØ TØ 270
25    CØNTINUE
*
*    PRØCESS AXES RECØRDS
*
      CALL BUFFERIN(2,1,IBUF,110,IND)
```

```
100   IF(IND.EQ.1) GO TO 100
      GO TO (100,110,500,200)IND
110   DO 120 I=2,6
      II=I-1
      CALL UNPACK(IBUF(I),X(II),Y(II),IMD)
      X(II)=X(II)+1.3
      Y(II)=Y(II)+1.1
120   CONTINUE
      CALL DRAW(5,X,Y,1,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
      DO 125 J=7,109,2
      CALL UNPACK(IBUF(J),X(1),Y(1),IMD)
      IF(IMD.NE.0)OUTPUT(101)'IMD ERR'
      CALL UNPACK(IBUF(J+1),X(2),Y(2),IMD)
      IF(IMD.EQ.0)GO TO 125
      X(1)=X(1)+1.3
      Y(1)=Y(1)+1.1
      X(2)=X(2)+1.3
      Y(2)=Y(2)+1.1
      CALL DRAW(2,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
125   CONTINUE
*
      CALL BUFFERIN(2,1,IBUF,1591,IND)
130   IF(IND.EQ.1) GO TO 130
      GO TO (130,140,500,25)IND
140   CONTINUE
150   MOD=2
      JJ=0
      DO 170 J=1,NSCAN
      DO 160 I=1,IWDTH
      JJ=JJ+1
      CALL UNPACK(IXY(I,J),X(JJ),Y(JJ),IMD)
      X(JJ)=X(JJ)+1.3
      Y(JJ)=Y(JJ)+1.1
      IF(JJ.EQ.1) GO TO 160
      IF(IMD.EQ.1) GO TO 160
```

```
      IF(JJ.LT.3) GØ TØ 155
      CALL DRAW(JJ-1,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
155   X(1)=X(JJ)
      Y(1)=Y(JJ)
      JJ=1
160   CØNTINUE
      IF(JJ.EQ.1)GØ TØ 165
      CALL DRAW(JJ,X,Y,2,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
165   JJ=0
170   CØNTINUE
      CALL BUFFERIN(2,1,IBUF,406,IND)
171   IF(IND.EQ.1)GØ TØ 171
      GØ TØ (171,172,500,350)IND
172   DØ 176 I=1,5
      DØ 175 J=1,80
      CALL UNPACK(JXY(J,I),X(J),Y(J),IMD)
      X(J)=X(J)+1.3
175   Y(J)=Y(J)+1.1
      IF(I.EQ.5)MØD=3
      CALL DRAW(80,X,Y,MØD,0,IB,ITITLE,XSC,YSC,0,0,2,2,IW,IH,0,LAST)
176   CØNTINUE
179   IF(SENSE SWITCH 6) 20,180
180   IF(SENSE SWITCH 5) 25,20
*
*    SKIP BAD RECØRDS
*
200   ØUTPUT(101)'SKIP BAD RECØRD'
      CALL BUFFERIN(2,1,IBUF,1,IND)
210   IF(IND.EQ.1) GØ TØ 210
      GØ TØ (210,25,500,25)IND
250   DØ 260 I=1,12
260   ITITLE(I)=4H
      ØUTPUT(101)'INPUT TITLE'
      READ(101,300) ITITLE
270   DØ 280 I=1,12
```

```
280   ISUB(I)=4H
      ØUTPUT(101)'INPUT SUB HEADER'
      READ(101,300) ISUB
      GØ TØ 25
300   FØRMAT(12A4)
350   ØUTPUT(101)'DATA CHECK ERR'
      GØ TØ 25
500   ØUTPUT(101)'END ØF TAPE'
      REWIND 1
      GØ TØ 20
600   ØUTPUT(101)'END ØF PLØT'
      IEND=0
      REWIND 2
      GØ TØ 20
*
*    NEED $ CØNTRØL CARD WHEN LØADING DRAW PRØGRAM FM CARDS
*
      END
```

PROGRAM "GRAPH PLOT"

"GRAPH PLOT" is a library program on paper tape and is used with the CDC 160 computer to drive the CALCOMP 563 plotter. It is found in the Electrical Engineering Computer Center of the U. S. Naval Postgraduate School.

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13. ABSTRACT


This is a report of a search for propagation anomalies using a large quantity of high frequency data produced as a byproduct of BRIGHAM, a Department of Defense project. The BRIGHAM data is based on 890 KHz wide samples of the HF spectrum at a 25 cycle rate, using a 2.8 KHz resolution for a duration of approximately 2.5 minutes. This method of data collection is unique and it was hoped that propagation anomalies, including wide band anomalies, might be detected. Anomalies are believed to occur in the propagation of radio signals and they are usually other than known, routine effects but may include known effects which cannot adequately be explained. The scope of this examination was limited to the visual analysis of computer processed data presented on an interactive graphics unit.


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| Anomaly | | | | | | |
| BRIGHAM | | | | | | |
| Electromagnetic | | | | | | |
| HF | | | | | | |
| High Frequency | | | | | | |
| Panoramic Receiver | | | | | | |
| Propagation | | | | | | |
| Radio Signal | | | | | | |

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